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THE FAR-REACHING INFLUENCE OF ELECTRICITY.

On several occasions attention has been called to the peculiar position occupied by the electrical industry in the world of to-day. Electrical applications have most generally been made as an improvement of methods used in older industries. The new system has not been installed for its own sake, but merely to improve the conditions previously existing. Thus, electric lighting replaces gas because it gives better illumination and is more convenient. The electric motor has replaced the overhead line shaft and belts in the factory and the horse on the streets, because it gives more satisfactory results. The new device has been merely a new means to an old end, though, of course, the end sought in its adoption has been better than that formerly thought satisfactory. It is this feature of electrical engineering that gives it its wide scope and brings it into touch with so many phases of industrial activity. Another interesting feature connected with the study of electricity is the part which it seems to play in modern physical science.

These two phases of electrical development in both the applied and purely scientific fields have recently furnished themes for two formal addresses. At the graduation exercises of Worcester Polytechnic Institute, Mr. Charles F. Scott, in an address in which he pointed out some aspects of electrical development, called particular attention to the wide influence which this is having. After showing the important position which has been taken by the engineering profession to-day, he said that this was best illustrated by that of electrical engineering. Electricity was not something separate and apart from other things, but enters into them; it operates and makes active that which is inert; and upon this depends its well-nigh universal application and service in every other branch of engineering. As a result the electrical engineer holds a unique position; he is becoming a general engineer, for all his work must not only fit in with that of others, but usually has to do with processes and methods that must be inherent adaptation. Electrical engineering pure and simple, when isolated from other things, has a very narrow field. As soon as it leaves the laboratory it comes in contact with other departments of engineering. With this idea in mind, the suggestion respecting the best method to be pursued in electrical education has particular significance. The aim should be a knowledge of fundamental principles rather than a mere acquaintance with apparatus. It should supplement this knowledge by training in methods of applying it to new problems; it should include the fundamentals of different branches of engineering, of which

electrical engineering is a coordinate element. In this opinion Mr. Scott will find himself in good agreement with the greater number of teachers of electrical engineering. The tendency to-day is in the direction outlined, which is surely a recognition of the universal applicability of what is so frequently called the flexibility of electrical systems.

The other address referred to was delivered at a recent meeting of the British Association for the Advancement of Science by the president of the engineering section, who this year is Dr. Silvanus P. Thompson, who for nearly a generation has been closely identified with electrical engineering. Dr. Thompson's address was a discussion of the development of electric motive power. Before taking this up he drew attention to the importance in our present civilization of scientific methods. He said that in looking back about a hundred years or more that the conditions to be found in the social and industrial worlds, as compared with those now existing, were not in any appreciable degree due to changes in manners, philosophy, religion or law, but to science and its applications; that in engineering, above all other branches of human effort, we are able to trace the close interaction between abstract science and its practical applications. Every one is familiar with the doctrine that the progress of science ought to be an end in itself; that scientific research ought to be pursued without regard to its immediate application. The importance of a discovery must not be measured by its apparent utility at the moment. Dr. Thompson goes on to show that this has not been the actual process; that in nearly every case important scientific principles have been found as the result of an investigation started for some useful end. Sometimes, of course, the useful end may be a scientific one, but most frequently it is purely utilitarian. There are scientific investigators who can not pursue their work if troubled by the question of ulterior applications, but very often the work of these has been suggested by some very practical problem. There are also others, no less truly scientific, who can not work without that definiteness of aim which is given by a practical problem awaiting solution. Dr. Thompson then shows that the study of magnetism was not taken up until this had been suggested by the application of the magnet in the mariner's compass. Volta's discovery of the voltaic current was stimulated by the medical properties attributed to electrical discharges. The invention and application of the telegraph led to the development of electrical science, and had there been no telegraph industry to make necessary electrical measurements, Maxwell's genius would have been turned in other directions, and we would not have to-day his electromagnetic theory of light. On the other hand, the influence of pure science on application is illustrated well by Maxwell's work, for without his theory of electrical waves in the ether there would never have been any attempt at wireless telegraphy. Each industrial application thus stimulates science, which in turn exerts a reflex influence on application. The effect is likened to what is observed in organic phenomena. The law that reaction opposes action ceases to be applicable, for the very instability thereby introduced is the essential of progress. The growing organism acts on its environment, and the change in environment reacts on the organism, not in such a way as to oppose the growth, but so as to promote it. So it is with the development of pure science and its practical applications. The two are not antagonistic, and where they appear so is due to the inability of the particular investigator to study without prejudice any problem presented to him.

ELECTRICAL SMELTING OF IRON ORE IN CALIFORNIA.

There have been many attempts to smelt iron ore in the electric furnace made both in this country and in Europe. Those on this side have so far been experimental, and are not in commercial operation. What has been the success in Europe is not clear, for, although reports in the technical papers would seem to show that several methods were successful in producing particular grades of material, there have been other and apparently reliable reports which point to the conclusion that no iron or steel prepared in the electric furnace is yet a staple product.

One of the notable attempts to apply the electric furnace to smelting iron ore was that made a short time ago at Sault Ste. Marie. Here the idea was to produce a special brand of nickel steel. The Héroult furnace was employed, and from all accounts the operation was successful. The plan seems, however, to have been dropped by the Canadian government, which made the experiment, the reason given being that although the process was successful, the price offered for the product was much less than what had been expected, and for this reason the process was not commercial.

Another experiment is now being conducted in California, the same furnace being used, and the preliminary reports seem encouraging. A description of the experimental plant was prepared by Mr. R. L. Phelps for the *Mining and Scientific Press*, which has courteously given permission to reproduce it. This description will be found on another page. The Héroult method of passing the current through the slag is used, but in this instance a three-phase furnace is employed instead of a single-phase. And, moreover, the object of the California experiment is to produce pig iron, and not a high grade of steel.

The reason for undertaking the experiment was the discovery of a large deposit of excellent iron ore, consisting almost entirely of magnetite, in Shasta county. There is no supply of cheap fuel available, although there is sufficient wood to provide the charcoal necessary for reducing the ore. However, cheap electrical energy is available, as the Northern California Power Company's generating stations are only about thirty miles away. It is said that electrical energy is supplied by this company at the very low rate of $12 a horse-power-year. The first experiments were promising, though, as might have been expected, some accidents happened. These, it seems, had nothing whatever to do with the furnace itself, but were breakdowns of auxiliary appliances, in one instance the supply line being

broken by injudicious blasting conducted on a new railway line. For these reasons the furnace was shut down, and the charge froze, but not before some samples had been drawn off for testing. The furnace was started again later, and five tons of pig iron secured. The report of the analysis of the samples shows that a good quality of iron was being produced, such as sells in San Francisco at from $30 to $32 a ton. The price for this same grade is about $10 less at Pittsburg, the difference in price being due to California's unfortunate location as regards its fuel supply. The material, it is estimated, can be turned out from the electric furnace at not more than $18 a ton.

If these reports are substantiated by further experiments, the event is an important one for the western section of the country. No one has ever questioned the possibility of producing pig iron or any grade of steel or iron in an electric furnace. Electrical energy is, however, usually expensive for heating purposes, and this is particularly true if compared with the thermally efficient blast-furnaces of to-day. Moreover, the utilization of the waste gases of these furnaces in gas engines has placed them on a still higher plane, and makes it even more difficult for the electric furnace to compete. As has been pointed out frequently, for some time at least, the new type of furnace seems destined to be used in iron and steel making to a limited extent only, either for producing special grades of material or for treating ore that is not suitable for the ordinary furnace; or in those sections where fuel is scarce. In such localities the cost of smelting will depend largely upon the cost of the electrical energy, and unless this be low, as is the case in California, it seems hardly likely that the process will succeed. It may be recalled that the Canadian commission, in reporting upon the successful production of nickel steel at the Sault Ste. Marie plant, said that there were certain sections in Canada where an ample supply of water power was available which could be produced at a cost of $8 or $10 a horse-power-year, yet nothing is now being done there, and it is well, therefore, not to build too confidently upon the California undertaking until more has been learned about it. It is, however, to be hoped that this experiment will be found a success in every way.

WIRELESS TELEGRAPH IMPROVEMENTS.

In a recent communication to the *Electrician,* of London, Professor R. A. Fessenden states that he has developed a new method of setting up electrical impulses which gives better results than that heretofore employed, not because it enables a message to be sent farther than previously, but because this particular type of impulse does not seem to be as much affected by the difference in atmospheric conditions existing during night and day. With the old method an effect could be produced at night which was many times stronger than that produced during the daytime by the same intensity of impulse. Some time ago, in commenting upon this feature, it was pointed out that this was undesirable because of the great difference between the two results; and it was said that to solve the problem properly a better understanding of the causes for this difference was necessary, and that until the matter was under better control, great wireless progress could not be expected. From Professor Fessenden's communication it does not appear that he has found out what it is that causes the damping-out of the electrical waves, but if he has found a method of diminishing this effect he has made an important step, for not only will this make the difference between the effectiveness of transmission by day and by night less, but it should give some hint of the cause of the damping, or at least offer a field for investigation with prospect of success.

That the new impulse is not as effective by night as the old is a disadvantage, but this is overshadowed by the great advantage gained in the uniformity of transmission. The importance of this Professor Fessenden clearly realizes, and he thinks that it ensures successful transatlantic communication. It is to be hoped that he will not be disappointed in this.

There is, however, another pressing wireless problem awaiting solution, and that is the development of commercially practicable selectivity. Until a number of stations can work side by side without affecting one another, the field for the new system is certainly limited. One cable across the Atlantic will not begin to handle the messages which are now transmitted daily, and until the wireless systems can handle something like the same number of messages, the cable system has nothing to fear. Given a selective transmission, an equally good transmission by day and by night, transatlantic transmission will become practicable; but until both of these problems have been satisfactorily solved, the wireless system must be content with a very subordinate position.

THE SEASONING OF TELEGRAPH POLES.

A problem of increasing importance in electrical engineering is the preservation of wooden poles used for supporting transmission lines, whether these be employed for telephone, telegraph or power purposes. A good deal of experimenting has been done of late upon methods of preserving poles, and some encouraging results have been secured. Unfortunately, all of these methods are more or less expensive, though experience seems to indicate that in the end they pay. Certain methods have been employed in Europe for some time, and not long ago a report was published of experience in Germany, which seemed to show that careful treatment would increase the life of a wooden pole two or three times.

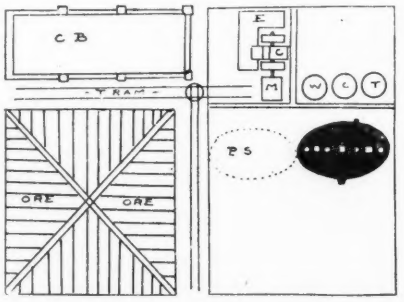
An important phase of this problem seems to have been overlooked, or rather not given sufficient attention, and that is a careful study of the best conditions for seasoning poles. This should be the first step in the process of preserving poles, and it seems likely that careful attention to the conditions will not only improve the poles very considerably, but make them more suitable for a later preservative treatment. For this reason a bulletin issued recently by the forest service of the Department of Agriculture, Washington, on the seasoning of poles, is of considerable interest and importance. This has been prepared by Mr. Henry Grinnell, and a full abstract is given on another page of this issue.

THE ELECTRICAL SMELTING OF IRON ORE.[1]

BY R. L. PHELPS.

It was only a short time ago that the first smelter for the electrical reduction of iron ore by the Héroult process was erected at Sault Ste. Marie under the auspices of the Canadian government. The success attendant on this experiment in the East suggested to H. H. Noble, president of the Northern California Power Company, the possibilities of such a smelter for the reduction of iron ores found on the divide between the Pitt and McCloud rivers in Shasta county, California. The idea seemed feasible, particularly on account of the economic advantages offering themselves in this vicinity. Adequate electrical power could be obtained from the lines of the Northern California Power Company, running within a mile of the deposit, a plentiful supply of first-class limestone adjoined the iron ore, and unlimited timber was available for making charcoal. The chief uncertainty lay in the fact that at the Sault the smelter was operated with a single-phase alternating current, and in Shasta county the power available was three-phase sixty-cycle alternating. The character of the current was such that it was feared trouble might occur through short-circuiting between the three electrodes that would have to be employed in a three-phase system. As there had been no previous experiments with three-phase currents in a smelter of this design, the engineers naturally took special care to prevent any possible short-circuit. It was suggested that division walls might be constructed between the electrodes in the furnace, but these walls would reduce the capacity of the furnace. As stated, Mr. Noble decided to install a Héroult electric smelter to treat the Pitt river deposits, the experiment being made entirely at his own personal expense. A suitable site was chosen on the Pitt river, about six miles from its confluence with the Little Sacramento river, and about eight miles from the town of Kennett on the Southern Pacific Railroad. Since construction began on the smelter the broad-gauge railroad of the Sacramento Valley & Eastern has been commenced from the Bully Hill copper smelter to the Southern Pacific Railroad. This railroad passes the Héroult smelter so as to afford an outlet for the product, as well as convenient transportation of supplies to the smelter. Arrangements were made with C. B. Morgan, of the Shasta Iron Company, for a supply of ore from the Pitt river mine. This ore is magnetite; an analysis of about 400 tons at the smelter gave the following results: Fe, 70.2; SiO_2, 2.4; insoluble, 2.8; S, 0.012; P, 0.01 per cent. It is interesting to note the small percentage of sulphur occurring in the magnetite as compared with the heavy sulphide copper ores of the Iron Mountain and Mammoth mines, only a few miles away. The deposit of magnetite occurs as a big mass, 100 to 250 feet wide, following the contact between diorite and limestone; it is seen on both sides of a steep ridge and has evidently been exposed by erosion.

The method of mining is by quarrying from the side of the deposit facing the McCloud river. The face of ore now exposed is about 250 feet high. A quantity of ore has been brought by wagon from the mine to the smelter, a distance by road of three miles; later, a surface trolley tramway, 5,000 feet long, will be constructed around the side of the mountain to a point on the ridge directly behind the smelter, the ore being taken thence to the smelter itself by an ærial tramway, 3,000 feet long.



PLAN OF WORKS.

W. C. T. Water-cooled Transformers.
E. Charge and ore elevator.
C. Crusher.
C. B. Charge Bin.
P. S. Proposed additional furnace.
M. Direct-connected motor

The erection of the smelter and necessary buildings has been superintended by N. Petinot, an experienced mechanical engineer. Paul Héroult, the inventor of the method of electrical smelting, has arrived to witness the experiment.

The smelter is housed in a concrete and structural steel building covered with corrugated iron to insure strength and protection from fire. The sketch of the floor plan of the smelter will give an idea of the arrangement of the water-cooled step-down transformers that deliver to the electrodes 30,000 amperes at fifty volts sixty cycles from the 22,000-volt potential of the power transmission line. Connection from the transformers to the electrodes is made by copper and aluminum bus-bars through apertures in the concrete partition wall separating the transformer room from the furnace and flexible bare copper cables lead the current from these terminals to the water-jacketed electrode holders.

The smelter itself is elliptical in form, with one compartment, standing about five feet high, made of heavy sheet steel and lined inside with the best magnesite brick. The bottom of the furnace is formed of heavy cast-iron plates with a covering of tamped carbon to form the neutral point of the circuit. The bottom plates are insulated from the upper parts of the furnace with asbestos. A tap and trough are provided on one side to draw the molten pig iron on to the molding beds. Owing to the small amount of slag produced in this furnace it is not necessary to provide a tap for removal of the slag. Any slag produced from the charge is exceptionally beneficial in this process as it offers an efficient resistance medium. The practice is to keep the electrodes in the slag rather than in the molten metal, the result being a better quality of product. Through apertures in the top cover of the furnace, the three carbon electrodes are introduced; these carbons are eighteen by eighteen by seventy-two inches, and were made in Sweden. They are fastened by wedges to a copper holder, which is water-jacketed, and by mechanical means these are lowered and raised from the furnace when necessary. Four combination charging and draft tubes are placed on the top cover of the furnace. These tubes consist of an inner tube made of steel and an outer tube made of cast iron, so as to leave an annular space large enough to serve as a conduit for the gases that are generated. Bunsen burner slots are provided in the base of each outer tube to allow enough oxygen to enter, in order to complete the combustion of the gases liberated from the charge. The burning of these gases in the annular space heats the charge as it is fed through the inner tube to the furnace, thus delivering the charge hot instead of cold. The inner tubes pass to the charging floor above the smelter. The gases are drawn through a chamber under this floor to the stack and the inner charging tubes are continued through the floor.

The charge is made of charcoal, lime-

[1] Reprinted by permission from the *Mining and Scientific Press*, July 20.

stone and ore. The charcoal is burned in kilns close to the plant. The heat for smelting the ore is obtained from the resistance of the slag and charge to the current as it passes from the electrodes to the neutral point; consequently, at the start the electrodes are in slight contact with the neutral bottom of the furnace. As the charge becomes heated the electrodes are drawn out of the molten iron and remain in the slag and charge.

Water for cooling the water-jacketed transformers and electrode holders is furnished by an eight-horse-power centrifugal pump.

The current was turned on for the first time on June 29 to dry the lining and test the electrodes.

On the evening of July 3 the current was again turned on and the furnace warmed up for the formal start on the morrow. About 10 o'clock on July 4, the furnace being sufficiently heated, a charge was added and the real experiment began. The daughter of Mr. Noble had the honor of feeding the first shovelful of ore. With a low steady hum of the current, the smelter ran successfully for three and one-half hours, reducing the charge until molten iron collected in the bottom. This proved that the furnace could be operated by a three-phase sixty-cycle alternating current. At the end of three and one-half hours difficulty was found with the centrifugal pump, which refused to deliver enough water to keep cool the transformers and electrode holders. Fearing a possible rupture of the entire electrical system through the overheating of the transformers, it was decided to shut down the furnace until provision could be made for better service from the centrifugal pump. The furnace had been run long enough to prove that it was perfectly possible to operate successfully on a three-phase system, and also that enough pig iron had been smelted to prove the feasibility of the electrical reduction of the Pitt river magnetite. Preparations are being made to operate the smelter again to reduce the 400 tons of ore ready for the furnace.

THE FUEL-TESTING PLANT OF THE UNITED STATES GEOLOGICAL SURVEY NEAR NORFOLK, VA.

BY C. T. WILKINSON.

The fuel-testing work of the United States Geological Survey should be followed with close interest by all engineers, not only because it is important to all power consumers, but in this branch of the Government work, because it is undertaken to point out new paths for the development of the natural resources of the country by locating, classifying and testing all kinds of available fuel.

In Europe, where the fuel resources are now fully known, there has been no need for so powerful an organization as that which is now rapidly making the resources of this country as well known to the public as that of the older European countries.

Accurately compiled results of the more recent work of this branch will soon be published, and the following particulars of the plant in Virginia will doubtless be of interest.

Fig. 1 shows the exterior of the Power and Alcohol Building in the grounds of the Jamestown Exposition. New apparatus has been added as follows: A 250-horse-power Babcock & Wilcox boiler, with superheater, provided with a Roney stoker (Fig. 2); a Jones underfeed stoker with fan, added to one of the old Heine boilers; two direct-current DeLaval turbine sets (Fig. 3) rated at 300-horse-power at 9,000-900 revolutions; also three Green Fuel Economizer Company's induced draft fans.

The method of work planned for this section is to be slightly changed, so that instead of testing a great number of coals, more tests will be made of the same coal, different sizes and different methods of stoking or feeding, etc., being employed with the object of determining the most economical performance under different rates of combustion and the best ratios of grate and heating surfaces.

The Babcock & Wilcox boiler will be placed beside the two Heine boilers which have been brought from St. Louis, all three having been provided with induced draft apparatus in order to get a wide range of capacity. The Heine boiler provided with the Jones stoker has the usual arrangement for forced draft. The Babcock & Wilcox boiler was inserted partly to enable tests to be made of the same fuel with different types of boilers. It serves to represent the types employing a perpendicular flow of the gases through the tubes, the parallel flow types being represented by the Heine boilers. The Heine boilers have been rebaffled or partitioned in such manner as to practically double their length by compelling all the heated gases to pass along the entire length of the tubes twice.

An additional alternating-current turbo-generator set may be installed to supply power for external and exhibition purposes.

The steam-engineering division, which has now practically succeeded in isolating the performance of the boiler from that of the combined performance of the boiler and furnace, will carry on further tests with the object of still further determining the performance and efficiency of the furnace alone.

The apparatus in the producer-gas section is arranged as shown in Fig. 7. The producer gas, immediately on entering the building, passes through the meter and thence to the Westinghouse gas engine transferred from the St. Louis plant, shown in Fig. 4. Some slight changes have been made in this apparatus. For instance, producer No. 7 has been provided with a water seal at the base to permit the ashes to be removed without

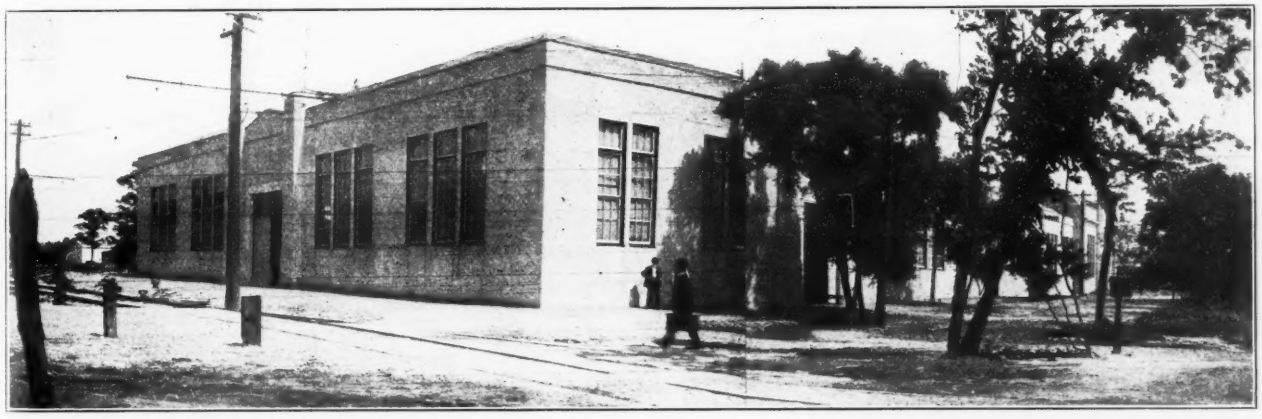


FIG. 1.—POWER AND ALCOHOL BUILDING, JAMESTOWN EXPOSITION, IN WHICH GOVERNMENT FUEL TESTING PLANT IS LOCATED.

admitting air, and several holes have been bored at different heights, to be used for extracting samples of the gas. The purifying apparatus used at St. Louis has been removed (this, it will be remembered, consisted of the usual chamber containing iron filings and wood shavings), since experience indicates that the danger from impurities has been considerably exaggerated.

A special steam pipe has been provided to insure a steady water pressure, since the pressure of the supply mains fluctuates considerably.

The gas engine is belted to a 200-kilowatt Bullock generator brought from St. Louis, which serves to drive the motors for the apparatus in the building, the machine shop, the briquette plant, the elevators and the conveyer. Any additional load required is obtained by means of a water-box resistance, which can be regulated by the switchboard attendant so as to maintain a steady full load value.

The plans of this section include the following determinations:

The proper length for a test run, the effect of the size of the coal, the best depth of fuel bed, the effects of rapid load variations, the maximum returns from different fuels, and the response of a producer plant to sudden demands for power.

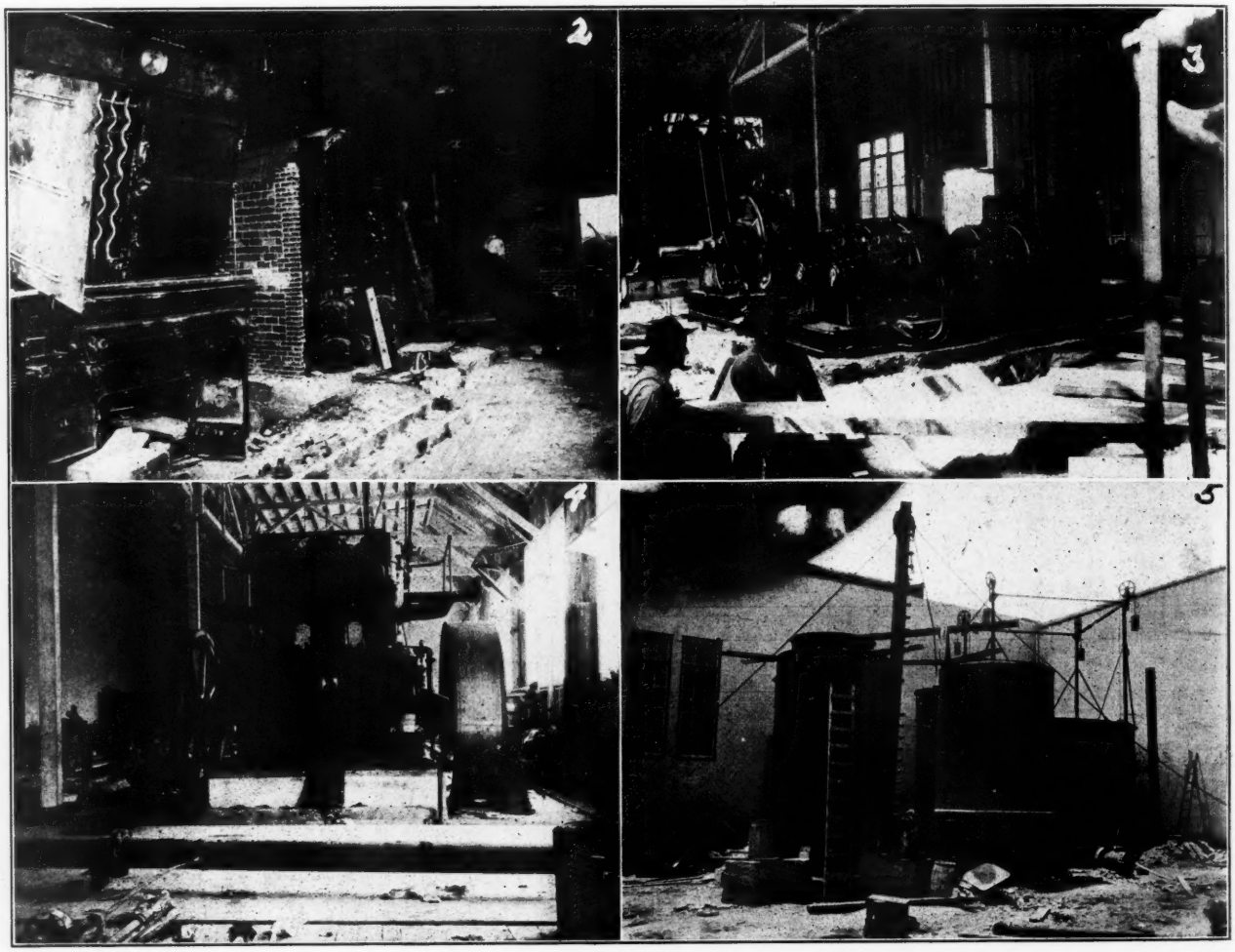
A new work of great importance is being undertaken by this section. Its equipment includes two fifteen-horse-power, 250 revolutions per minute, Otto gas engines; two fifteen-horse-power Nash Company's engines; one two-horse-power International Harvester Company's engine; and two John Deere engines rated at fourteen and eighteen horse-power, respectively.

Experiments will be made covering the whole range of this field, but for the present the work will be confined chiefly to examinations of different carbureters with the object of showing the lines along which a more efficient method of vaporization may be obtained. The other more prominent work is the examination of the kinds of fuels available, with special reference to gasolene *versus* alcohol, and an investigation of the use of kerosene as fuel for this class of engines; an investigation necessitated by the increasing demand for gasolene and the limited supply available.

The study of the destructive distillation of the coal and its combustion in gas producers, coke ovens and furnaces, especially from the standpoint of physical chemistry, will be undertaken by several divisions.

The briquetting division, which occupies the large room at the end of the building, is putting down one additional German briquetting machine, while the previous apparatus of English and American manufacture, that was used at St. Louis is installed in the same room.

The further fuel-testing work of the Geological Survey includes tests dealing with the spontaneous combustion of the stored coals, in which an effort will be made to simplify the methods for its preventation; while a corps of specialists will be detailed to investigate closely the whole subject of explosions in coal mines with a view to eliminating danger from this source.



FUEL-TESTING PLANT, JAMESTOWN EXPOSITION, NORFOLK, VA. 2.—INTERIOR OF THE BOILER HOUSE. 3.—DIRECT-CURRENT DELAVAL TURBO-GENERATOR, BULLOCK ALTERNATOR AND WESTINGHOUSE ENGINE. 4.—225-HORSE-POWER WESTINGHOUSE GAS ENGINE. 5.—GAS PRODUCER PLANT.

The Kern River No. 1 Power-House.

Description of One of the Hydroelectric Plants of the Edison Electric Company, Los Angeles, California.

THE Kern river No. 1 project of the Edison Electric Company of Los Angeles, embraces the diversion of Kern river at a point about one-half mile below Democrat Springs, in Kern county, and the conveyance of the water in a conduit approximately eight miles in length through the mountains on the southerly side of the river to a point on the mountain side directly opposite the intake of the Bakersfield Power Transit and Light Company, and at an elevation of about 900 feet above the river at that point.

At this point on the mountain side a forebay was planned from which the force main incline tunnel was contracted down to the power-house, the power-house being situated on the banks of the river, directly opposite the intake of the Bakersfield company, and at an elevation of about twenty feet above the ordinary high-water level of the stream at that point.

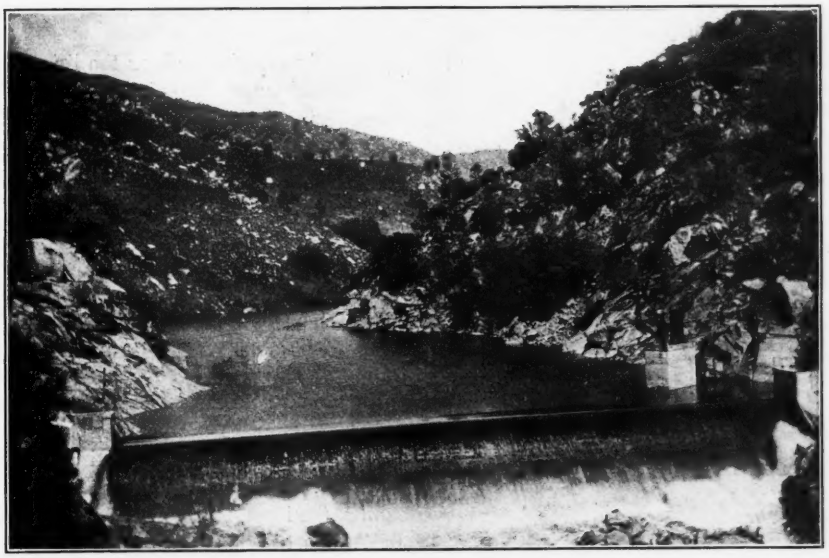


FIG. 1.—THE DIVERTING DAM ON THE KERN RIVER.

The project is planned so as to return the water to the stream for the Bakersfield plant at a point immediately above its diversion.

The diverting dam of the Edison Kern river project, shown in Fig 1, is constructed of Cyclopean concrete, being placed on bed-rock and extended up to a point 1.25 feet above the flow line in the tunnel conduit diverting the water from the stream above the dam. The length of this dam on the crest is 203.56 feet.

The form of the dam is the overflow type, and its height above ordinary water level in the river is about twenty feet.

The diversion works consist of an enlarged or widened section of the intake tunnel with controlling gates operated by means of hydraulic cylinders.

Another important part of the head works is the drainage or sluicing tunnel that is driven through bed-rock below the intake, penetrating to the bottom of the pool above the diverting dam. The entrance of this tunnel is protected by means of a grizzly of seventy-pound T-rails and has two gates operated by means of hydraulic cylinders, by means of which it can be closed and opened as desired. The drainage tunnel was originally used to divert the water above the site of the diverting dam during its construction. Its permanent purpose will be to sluice out any accummulation of silt collecting in the pool above the dam.

The hydraulic cylinders, both for the gates at the intake and the sluice-gates in the drainage tunnel are operated by means of oil pressure which is pumped up by a triplex pump, electrically driven.

There are approximately eight miles of gravity tunnels from the intake to the forebay. These tunnels were excavated in the rough to be nine feet in width and seven and one-half feet from the bottom to the spring line of the arch, and nine feet in height in the centre. Afterwards they were lined with concrete six inches thick on each side and the floor paved with four inches of concrete, the net section thus obtained being eight feet in width by seven feet in height. The entire surface of the side and the floor was plastered with a cement mortar, one part of cement to two parts of sand. In places where the tunnels pass through seamy and shattered formation or "blocky" ground, they had to be arched overhead in order to support the roof. Less than fifteen per cent of the length of tunnel required overhead arching.

Wherever large cavities had been blasted out in driving the tunnels, these were filled with backfill of riprap, the interstices of which were filled with sand and gravel. The same method was pursued above the concrete in the arches. Hence, there are no cavities existing between the bed-rock and the concrete lining in the tunnels.

The rule in planning the work was to avoid flumes for spanning ravines encountered along the line. A few exceptions had to be made to this, however, in order to maintain a good alignment and make the line as short as possible. All are timber flumes except one, which is built of a steel frame and reinforced concrete.

The flumes are in all cases placed on concrete foundations and designed with a factor of safety sufficient to make their life from thirty to forty years. The framework for supporting the flume-box is of Oregon pine, being so designed and distributed that no part of the timber comes in contact with the earth or is exposed to the drip, should the flume at any time spring a leak.

The flume-box is of three-inch redwood planks, obtained from butt ends of Sequoia Semper Virens, grown in swamp lands west of the coast range in northern California. The grain of this lumber is perfectly clear, and its quality is such that its life will be not less than forty years.

The flume between tunnels No. 6 and No. 7 across Laird Cañon is constructed of structural steel and concrete.

The opportunity for the construction of a terminal reservoir did not exist in connection with the Kern river No. 1 project. The slope of the mountain where the tunnel emerges above the power-house is approximately on a forty-five degree angle, making it impossible to excavate

any large area for a terminal reservoir or forebay. It was necessary, however, to have a small basin for regulating the flow into the force main, for which reason a chamber thirty by forty feet was excavated to a depth of several feet below the grade of the supply tunnel. Inside of this and over the mouth of the force main were erected controlling gates and screens through which the water passes into the force main, as shown in Fig. 2. On one side of this forebay is a spillway over which the water will flow into the waste-flume. The height of this spillway can be controlled by means of flash-boards, which may be inserted and removed as required, according to the quantity of water carried through the tunnels.

The construction of the force main is along new lines and is an innovation in the practice of laying a steel pipe on the surface or one that is merely buried sufficiently to cover it for protection against freezing or expansion and contraction, which may be caused by the wide range of temperature changes. In the present case the force main consists of an incline tunnel driven down through the mountain. This tunnel begins in the bottom of the forebay and runs below until it emerges at the lower end on a level with the floor of the power station. One end of the force main is finished to give it an inside diameter of seven and one-half feet, there being a taper twenty feet in length at the upper end, running from nine feet in diameter at the entrance, and terminating into the regular seven and one-half foot diameter of the completed tunnel tube. The diameter of seven and one-half feet is maintained for a distance of 1,172.3 feet. At this point the force main tunnel emerges from the solid rock into a detrital deposit lying between the mountain and the power-house site. The tunnel was driven through this detritus to its emergence at the power-house, a distance of 252.7 feet. The upper end through solid rock was finished by installing a steel lining made of plates three-sixteenths-inch thick, riveted together in the form of pipe seven and one-half feet, internal diameter. The tunnel itself was driven in approximately circular form and nine feet in diameter. The steel was centred in the tunnel, being installed in ten-foot sections, and the space between the outside of the steel lining and the bed-rock thoroughly filled with a mixture of concrete. The work of installing this lining was begun at the lower end just before the pipe is tapered down to the diameter of 5.25 feet, where it passes through the lower 252.7 feet of distance under the detrital fill which has already been referred to.

At this point a taper of one-and-one-eighth-inch steel plate riveted together with butt straps was placed back in the solid rock for reducing the diameter from seven and one-half feet to five and one-quarter feet. Around this a heavy bulkhead of concrete was constructed and anchored into the bed-rock by means of steel rods driven into the sides.

At the lower end from the taper reducing the diameter of the 252.7 feet of main pipe to five and one-quarter feet, it was made of one-and-one-eighth-inch steel plate, or sufficiently heavy to withstand the static pressure without any external support. No concrete was placed around this pipe, and the tunnel was

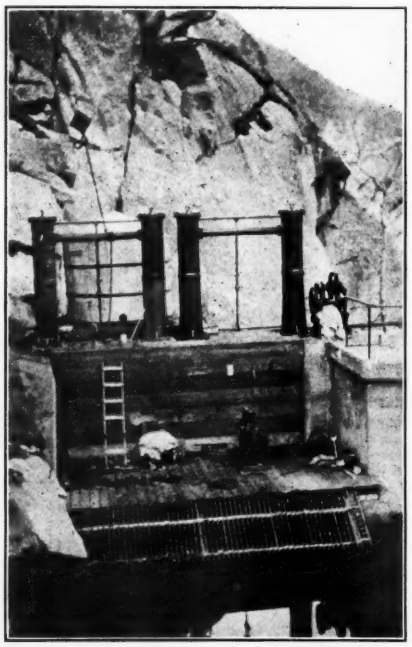


FIG. 2.—FOREBAY, KERN RIVER PLANT NO. 1.

merely left in its original condition with the timber sets to support the ground overhead.

From the end of this section of pipe, the header pipe was constructed of successive lengths of diameters graduated to maintain as nearly uniform velocity as possible after withdrawing the water for the various branches to supply the water-wheel units in the power-house. In reducing the force main at its various pipes to meet the diameters given, taper pipes were employed.

The branches from the force main were taken out by means of a Y on the header pipe and laid out in curved form, entering the power-house at right angles to the rear wall. These branches for each of the eight water-wheels are twenty-eight inches inside diameter, and for each of the two exciters ten inches inside diameter.

In each of the branch pipes leading from the force main to the water-wheels are installed two twenty-eight-inch gate-valves, one outside of the power-house, and the other inside; the former being intended solely for the purpose of closing off the branch pipe in case of necessary repair to the gate or piping inside of the house. These outside gates are arranged for hand drive only, while those inside of the power-house are equipped for operation either by hand or by electric motor.

The water is projected on the buckets of the impulse wheels through deflecting nozzles of the needle-valve type at the end of each of these twenty-eight-inch branch pipes. By means of these deflecting nozzles and needle valves, the discharge of the tip can be accurately regulated without disturbing the form of the jet.

There were places along the line where the tunnel emerged at the foot of a steep incline in such a manner that the flume if constructed on the grade would be threatened by landslides or boulders rolling down the side of the mountain. These places were spanned with concrete conduits, Fig. 3, the interior of which has the same cross-section and slope as the tunnels themselves. The walls are made heavy and reinforced with steel and an arch overhead, the arch being covered with a cushion of earthen material to receive the impact of anything rolling or sliding down the hill and passing over the conduit. There are eight of these conduits, the longest being 121 feet in length.

A construction plant generating 300 kilowatts at normal capacity was installed for furnishing power used when driving tunnels, mixing concrete, transporting materials, etc. This construction plant was developed by means of a flume about 800 feet in length which supplies water to McCormick reaction turbines operating one 150-kilowatt generator for each turbine. This plant furnished all the energy required while the work was in progress and was only abandoned after the completion of the main plant. From the construction plant, power was transmitted to all parts of the work over a temporary transmission line, and was not only used for the construction work, but for lighting both in the tunnels and camp quarters occupied by the men.

It can be said that the methods of construction employed were among the most

modern known to engineering practice. For driving the tunnels, compressed air was generated with electric power from the construction plant and piped into the various tunnels, where it was used for operating pneumatic drills. Ventilating fans for supplying fresh air at the face of the tunnels was also produced by means of blowers operated with electric power. In the construction of the diverting dam, a complete system of cableways designed by the company's engineers was installed, by means of which material was transported and placed in position in the dam. In the construction of the power-house, the handling of materials as well as crushing of rock and mixing of concrete, electric power did the work by means of the most modern equipment.

The normal rating of the power plant is 20,000 kilowatts. The machinery is all tested to operate under fifty per cent overload for peak load service, thus making the ultimate capacity of the installation 30,000 kilowatts, or 40,000 electrical horse-power.

The power-house foundations were started on bed-rock and cemented boulders, low enough to avoid any possibility of the power-house being undercut by floods, and were carried up as walls in such a manner that no important machinery rested on floors placed on backfill. All spaces between these walls which could not be utilized on account of their falling so low as to be subject to flood, were filled in with compact backfill from other portions of the work. A general view of the power-house is shown in Fig. 4.

FIG. 3.—CONCRETE CONDUIT, KERN RIVER PLANT NO. 1.

FIG. 4.—POWER-HOUSE, KERN RIVER PLANT NO. 1.

The upper part of the machine foundations carried a small amount of reinforcement. A large block of masonry back of each water-wheel deflector is heavily reinforced and tied into the main foundation blocks. The crane rail arches for the interior wall are reinforced concrete beams, with the exception of the long span above the switchboard, which contains an I-beam girder. The north wall is a twelve-inch curtain wall, reinforced with heavy pilasters, and this contains only sufficient reinforcement to render it reasonably secure against shock and vibration. The south wall of the building is of a cellular construction for about two-thirds of its height, in order to produce wiring ducts for the 60,000-volt connection. This wall also contains only nominal reinforcement. Between this wall and the interior crane wall a series of transverse partitions break up the area into transformer, switch and switchboard rooms. The transformer rooms are open up to the crane beam to permit of wheeling the transformers out under the main crane.

The switchboard space carries a deck eight foot six inches above the main floor level, upon which the control board is mounted.

In Fig. 5 is shown one of the generating units. These big impulse wheels, of which there are four, are of Allis-Chalmers Company make; the exciter turbines are also of Allis-Chalmers make. The generators were furnished by the General Electric Company. The water-wheels consist of two single-nozzle wheels for each generator, one wheel overhung on each end of the generator shaft. Each nozzle throws a seven-and-three-eighths-inch jet at full output. The nozzles are deflecting, and each pair is actuated by an oil-operated governor of the Escher-Wyss type, placed midway between them on their common rock shaft. These shafts are below the main floor line, and are accessible through a longitudinal shaft alley five feet wide and having clear head room of seven feet. The nozzles are equipped with needles for adjusting the size of the stream by hand.

Each wheel carries eighteen bronze buckets, twenty-seven-and-one-half inches wide, fastened to the cast-steel rim with bolts, and is designed for 250 revolutions

a minute, and to deliver 10,750 horsepower to the generator shaft from each pair of wheels. The efficiency guarantee requires that the water-wheel proper shall develop an efficiency at rated load of eighty-two-and-one-half per cent. Regulation at 100 per cent load variation is obtained within less than eight per cent when the units are carrying fifty per cent overload, and within less than five-and-one-third per cent variation of speed when running at normal load.

Dead water leaving these wheels flows down the floor to the wheel-race into the main tail-race. Live water, deflected past the wheel by deflecting the nozzle, passes over a pair of heavy metal deflector plates and is completely killed before reaching the main tail-race. The wheel-races are lined with steel on both sides and fitted with a steel back-plate to keep splash out of the shaft alley.

There has been left sufficient space between the two exciters to permit of the insertion of a large induction motor at some future time if it should be necessary. This motor would be designed for a good speed regulation and connection by means of a pair of clutches to either one of the exciters.

The governors are self-contained, oil-actuated, and have their pumps immersed in their oil reservoir. They are driven by a silent chain from the generator shafts.

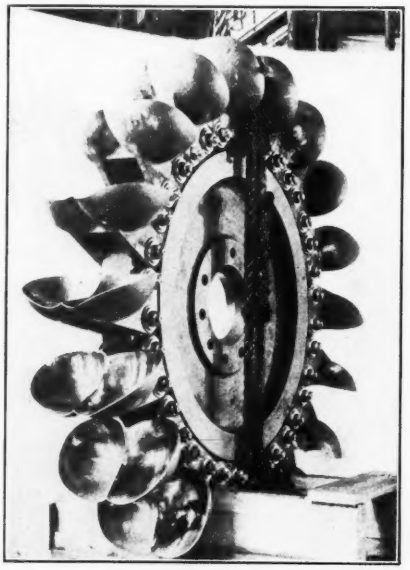
The main units are each carried on two sixteen-inch by forty-eight-inch babbitted bearings, each fitted with six oil rings for flooding them with oil from the cellars contained in their pedestals. While in the pedestals the oil is cooled by means of water coils built into them. Each bearing also has in its lower portion a number of small openings which are connected to a triplex power-driven pump, capable of supplying oil at a pressure of 1,000 pounds to the square inch.

The shaft is flared out at either end to form a flange to which is bolted a wheel disc. The shaft is also enlarged at the centre to carry the cast-steel pole rim and spider. This is a single casting weighing twenty-six tons. The pole-pieces are wedged to the exterior of this rim.

The stationary armature of the generator is bar wound for 2,300 volts three-phase. No unusual or exceptional features are incorporated in the generators. The exciters are also two-bearing, having a water-wheel on one end and a flywheel for close regulation on the other. These units are standard direct-current machines, generating at 125 volts, flat compounded, running at 430 revolutions and having ordinary self-adjusting bearings.

The station contains thirteen 1,667-kilowatt, oil-filled, shell-type, oil-circulated transformers in boiler-iron cases. These transformers are grouped in four banks of three each to receive energy at 2,300 volts, delta, from the machines and to supply it to the line at 75,000 volts, Y. Taps are provided for the intermediate voltages of 56,250 and 37,500.

These transformers, instead of having internal water-cooling coils, are so built that when the oil is supplied to them under a slight pressure, it will automatically distribute itself throughout their windings and return itself by gravity to the waste pipe. The piping and connections for this circulation are placed in the basement of the power-house, and consists of a four-inch supply line, a six-inch return line, and a four-inch waste. The oil coming from the transformers enters a receiving drum from which it is drawn by two five-inch centrifugal pumps, motor-driven by variable-speed direct-current motors. Either pump will supply the entire station in an emergency. These pumps force the oil through a set of boiler-tube coolers, having a total area of 4,500 square feet, and from them it returns to a pressure line which supplies the transformers. This system has carefully been laid out with strainers, by-passes and other auxiliaries so that the entrance of any foreign substance into the oil will not cause trouble throughout all the banks. As the system is under pressure from the time the oil enters the pump, any leakage will be outward and there will be no possibility of water leaking into the oil, as is the case where the water-coils under pressure are placed in oil-filled transformers.



IMPULSE WHEEL, 5,500 HORSE-POWER. 865-FOOT FALL, 250-R. P. M., FOR KERN RIVER PLANT NO. 1.

The cost of installing this kind of a system is also somewhat less than for a similar installation using water cooling.

Water for the cooling sections is by-passed from one of the exciter tail-races into a flume built across the top of the coolers.

The generator leads pass through ducts to the generator switches, from thence to the low-tension side of the transformer banks. The station is not equipped with a complete 2,300-volt bus-bar. There are, however, tie switches placed between adjacent machines equipped with double-throw switches in such a manner that in case of necessity any generator can be transferred by means of this transfer line to any single transformer bank, or in case of absolute necessity, run in multiple with some other generator on a single transformer bank, or, if desired, the entire station can be tied together by means of this transfer bus and operated as a single unit.

The transformer banks connect on their high-tension side through knife-blade switches to a single bus-bar which is sectioned in the middle. The two outgoing circuits are tapped off this bus-bar between adjacent transformer banks through oil switches. These switches are remote-control, non-automatic. By use of them and the oil section switch, all high-tension power switching can be handled without the use of air-break switches. At the same time, the investment for high-grade switching is reduced to a minimum. The 2,300-volt oil switches are installed in concrete cells with concrete barrier walls and tops. The disconnecting switches for them are also separated by barrier walls where possible. The 60,000-volt oil switches are not only installed in concrete cells in accordance with standard practice, but are each of them enclosed in a separate concrete room containing no additional apparatus except lightning arresters.

The high-tension wiring is run in ducts throughout, no open wiring being permitted except connections from transformers to the walls through their disconnecting switches, and from the lightning-arrester disconnecting switches to the lightning-arrester banks.

The lightning arresters are the General Electric multiplex type, consisting of al-

ternate carbon spark-gaps and resistance in accordance with their latest practice. The circuits are equipped with choke-coils, consisting of twenty turns of hard-drawn copper, after passing the lightning arresters and before entering the oil switches.

The leads after passing the choke-coils and tap for the lightning arresters, pass out of the building through rectangular openings, located immediately below the eaves. To prevent the drip from the long run of roof in back of this location from falling on them, a gutter extends for a few feet across the roof above each entrance. From the eaves of the building, the leads converge on to the first tower of the transmission line.

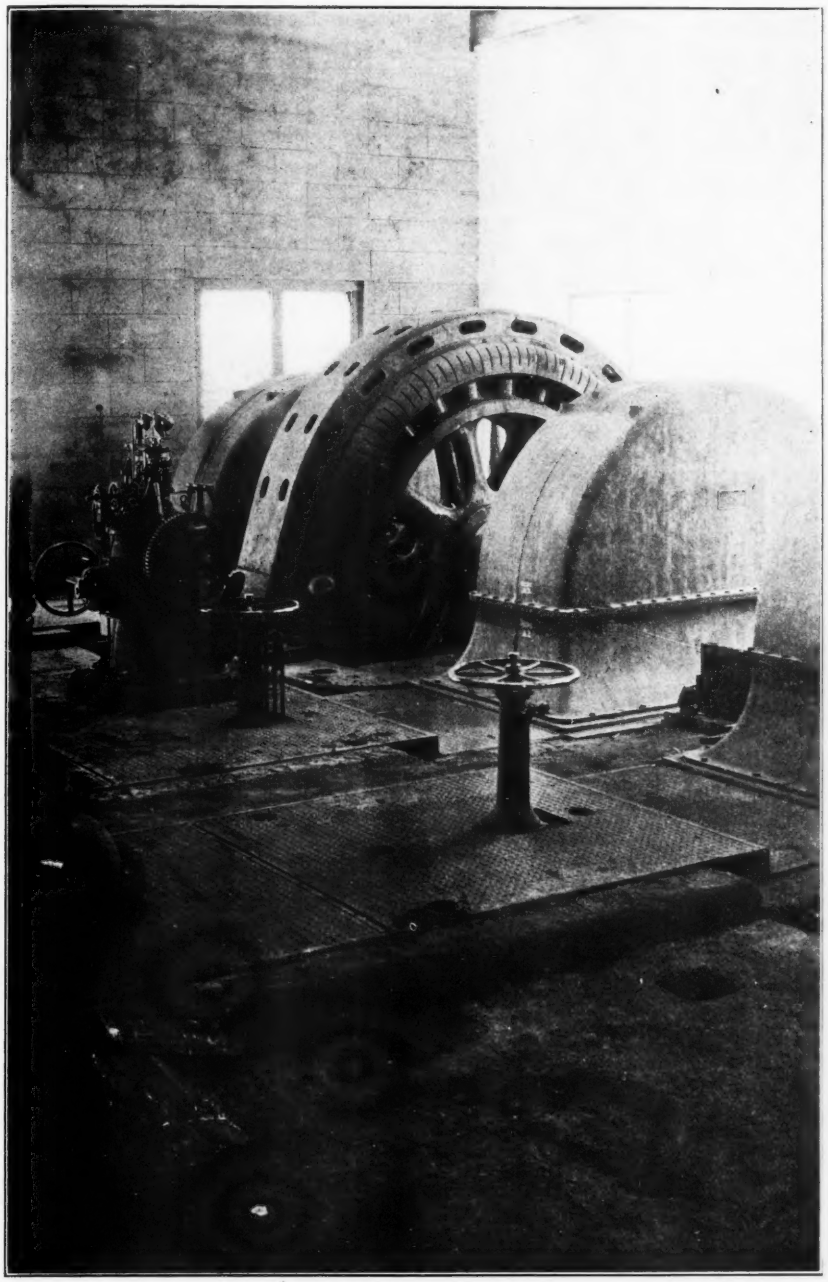


FIG. 5.—A VIEW IN THE GENERATING ROOM, KERN RIVER PLANT NO. 1.

From the power-house the transmission line runs in as near as may be a straight line to the mouth of the Kern river cañon, where it sweeps off to the left across the Cottonwood hills and then takes a due south course across the edge of the Bakersfield plains. The line then enters the mountainous section through Tejon cañon, follows across the end of Castaic Lake and across the divide immediately above German Station.

This is the steepest portion of the transmission line, as the drop from the top of the hill to the road below is over 1,000 feet in 3,500 feet. From here south the transmission line follows the waters in Piru creek and its tributaries, the character of the country changing gradually from low, rounded hills with grassy slopes, to deep narrow gorges walled with precipitous shale cliffs capped with sandstone ledges. Typical views along the line are given in Figs. 6 and 7.

A section here of about five miles involved very difficult work. Heavy angles, both vertical and horizontal, were necessary in a district where no permanent wagon road could be maintained, and where the tower footings were mostly in loose shale. One U-bend of the river was crossed by means of a long span, 2,250 feet between the main supports, guided by an entirely unloaded tower at the bottom of the sag.

Leaving the Piru cañon, the line passes in an almost straight line across about fifteen miles of rocky land, covered with scattered oaks and chaparral. After reaching the last crest of this district, the line falls away rapidly to the open country surrounding Newhall. Across this entire district it was necessary to construct a permanent wagon road to haul supplies and permit of patrolling the line during operation.

In the Newhall district, the line crosses the San Fernando Mountains directly west of the long tunnel on the Southern Pacific. After this, it is in sight from the railway trains most of the way to Los Angeles and runs most of the time through open country.

The tower heights range from thirty to sixty feet. They are uniformly constructed of galvanized angle iron, bolted with galvanized bolts and held in shape by means of tension rods. There are no compressive braces, except one pair in the upper portions of the sides and between the cross-arms.

The nine insulators are spaced on six-foot centres, five on the upper arm and four on the lower.

All portions of the tower are figured to be safe under a wind pressure of thirty pounds per square foot on the tower and the wire of a 700-foot span. The towers will also withstand absolute failure of any single wire, although none of the resulting strain is transmitted to adjacent wires.

The foot-plates are twenty-four inches in diameter, of cast iron, painted black. They are attached to the bottom of four by four-foot posts, which are painted black on top of the galvanizing, bolted

as extensions to the corner posts of the tower and set in the ground a depth of six feet. Tapered holes were dug for these foot-plates and the earth was tamped back on them very carefully. No concrete footings were used, except on some special work in Los Angeles, where a great many of the tower heights exceeded sixty feet. The tower parts were made as light as was consistent with rigid constructions. Under extreme conditions mentioned above the factor of safety in any steel member is specified to be not less than two and one-half.

No cast iron was permitted, except in the foot-plates. All connections are made with malleable iron castings with a factor of safety of four. The insulator pins are cast steel and furnished as a part of the tower. They bolt to the tower with four bolts and are cemented into the insulators.

The transmission line is designed to consist of three circuits with the wiring spaced symmetrically on six-foot centres. This wire is seven-strand, 4/0 hard-drawn copper. It was greased and shipped to the purchaser on reels containing usually two lengths of 4,000 feet each. Some wire was also purchased in shorter lengths for convenient use in the mountain section. No special difficulty was, however, experienced in handling full length pieces, even in the most rugged country.

The tie wires passing around the neck of the insulator are of No. 1 copper strand; the four-bolt clamps are of brass; while the U piece placed in the top of the insulator to prevent chafing is of No. 24 copper.

The transmission line is carried on spans as long as the character of the country would permit, with towers not exceeding sixty feet high. This maximum height was determined upon as the height which would give the lowest total cost of construction.

The transmission lines are carried through from one end to the other, with transpositions only at switching stations. There are at present only three such buildings, two of which contain transformer substations.

The switching station proper is equipped with two sets of oil-break switches for each line and two sets of knife-blade disconnecting switches for each line. The oil switches are connected, one set after another, into a complete circle. After passing through the disconnecting switches, the incoming lines are tapped between alternate oil switches. From the vacant jumpers left after these lines have been tapped in, their corresponding outgoing circuits are taken and after passing through the disconnecting switches, leave the building on the opposite side.

These buildings are constructed of concrete in the most substantial manner. These circuits are isolated from each other by means of concrete barriers and floors. Individual leads of the same circuit are, however, run in the same compartment. In spite of the large number of crossings called for by the wiring diagram, the dimensions of the building are not excessive. Provision has been made to connect horn lightning arresters to the circuits at these substations, if it is found necessary after the line has been operated for some time. The two transformer substations have in their switching houses an arrangement identical with that in the other stations, except that openings were made in the west wall, through which leads were taken into the adjacent transformer house. The two were built together under the same roof and with continuous side-walls so that there is on the exterior little to indicate the difference between the two ends of the station. In the transformer house provision has been made for two banks of 2,100-kilowatt transformers from the transmission line at 60,000 volts and delivering to the distribution at 30,000. The high-tension leads are tapped from two of the outgoing 60,000-volt circuits in the switching house, and after passing through oil switches join in a common

FIG. 6.—TYPICAL VIEW ON TRANSMISSION LINE, KERN RIVER PLANT NO. 1.

bus from which the transformers can be separated by means of knife-blade switches.

This switching, with the exception of the transformer switches, is on a concrete deck, forming a complete second story in the switching house. On the under side of this floor, there are also hung the insulators for the 30,000-volt circuits. The 30,000-volt oil switches are, however, placed on top of the floor. The lightning arresters for the 60,000-volt circuits are on the wall between the transformer and the switch house, and are separated from each other by six-foot barriers, while the 30,000-volt arresters are against the end of the substation immediately below the oil switches and the outgoing 30,000-volt circuits.

At Castaic there will be installed at present one bank of transformers, 2,100 kilowatts, oil-filled and water-cooled. These transformers will supply a 30,000-volt transmission, now being built by the Ventura County Power Company, west from Castaic to Saticoy, where a branch is taken off to Oxnard, while the main line continues to Ventura. This branch will eventually be continued to Santa Barbara, where the Edison Electric Company has extensive holdings.

At Fernando there will be installed at present a 1,200-kilowatt bank which will supply local light and power at 2,300 volts.

The transmission terminates in Los Angeles at the steam and transformers station known as Los Angeles No. 3. Both circuits enter the station through the east gable. After passing through choke-coils, the lines enter oil switches which connect them to their respective bus-bars. There is also an oil tie switch between the two buses. Each transformer has an oil switch which can be connected by means of a double-throw knife-blade switch to the bus-bar, belonging to the west or to the middle circuit. When the east circuit comes in it will have a pair of oil switches so that it can be run on either of the bus-bars. There are four step-down transformer banks, 4,500 kilowatts each, with their secondaries wound for either 16,000 or 32,000 volts. Under ordinary conditions, all energy received from Kern river will be handled through the double 15,000-volt bus. The transformers are oil-circulated. The oil after leaving the transformer is handled in the same manner as at Kern river.

This building also contains provisions for switching the old 30,000-volt transmission line with its various branches and all the 15,000-volt distribution around Los Angeles.

All bus-bars wiring connections to the transformers and the outgoing circuits are carried in ducts. In the new portion of the station these are pulled with 15,000-volt leaded paper cables of 211,000 circular mils cross section, with the exception of the Westinghouse generator, which has 400,000 circular mils cables.

There were installed in this plant during 1903 two 2,000-kilowatt, 2,300-volt Curtis turbine alternators, with 4,000-horse-power of Stirling boilers, in units of 500-horse-power each. When it became necessary to order an extension for the plant in 1905, larger size apparatus was determined upon throughout; 5,250-horse-power of 750-horse-power units was installed in the boiler room, and a steam turbine consisting of a single 6,000-kilowatt Westinghouse-Parsons turbo alternator, with Worthington condensing equipment, driving a generator wound for 16,500 volts Y, and run with grounded neutral on the fifty-cycle distribution of the company. The generator operates perfectly and runs in multiple with the main system without causing any disturbance whatever.

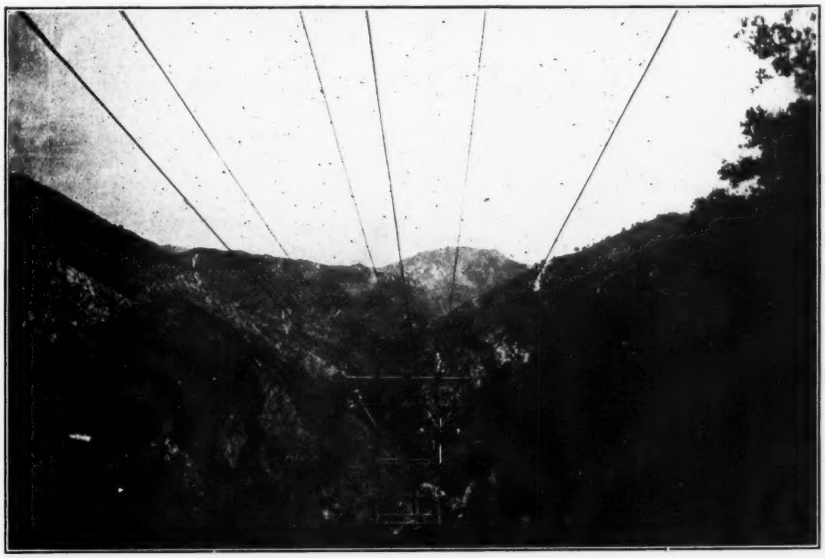


FIG. 7.—VIEW ON TRANSMISSION LINE, KERN RIVER PLANT NO. 1.

NEW LIGHTS AND NEW ILLUMINANTS FROM THE CENTRAL STATION'S POINT OF VIEW.[1]

BY R. S. HALE.

The new illuminants are devised by engineers and inventors, and are a great advance in the art of lighting.

The public in the form of customers of the central station uses the new illuminant and gets the advantage.

The central station is the intermediary between the inventor and the customer. From most points of view the central station makes and sells electricity rather than light, and if the central station produces and sells its product purely as electricity, then although the result might be important, yet the question of the method of handling the introduction of new illuminants would be of comparatively slight importance to the central station, or rather the central station has but little to do with it. When the central station is concerned with electricity only, it looks forward either to having the new illuminants give so much more light that they may cut down the total output of electricity, or, on the other hand, that the new illuminants may so increase the demand for light that the total output of electricity will increase; and if the central station is supplying only electricity, and taking no consideration of how it is used—in other words, if the central station pursues a policy of making no lamp renewals whatsoever — then, while the central station is interested in the result, it can do but little more than to wait.

If, however, the central station is supplying lamps and including the cost of them in its charge for electricity—in other words, is selling light—then the new illuminant comes before the central station manager in a very immediate and practical way; and in the following notes I have given some of the essential factors that can not be ignored, and some personal opinions which, however, I do not consider final. They are merely in the way the question strikes one at the moment.

In the first place the new illuminants are an improvement, and the word itself means that the new illuminants give a greater ratio between the light received by the customer and the current sold.

The immediate effect may be either that the central station sells the same number of units of electricity and the customer gets more light, or that the customer gets the same amount of light as

[1] A paper presented at the convention of the Illuminating Engineering Society, Boston, July 31.

before and purchases less electricity; and while the immediate effect must lie between these two points, yet the final result is effected by the increase in business, and may be such that even more units of electricity are used than ever before, and of course in such case, very much more light.

While it is possible that the new illuminants may permanently cut down the central station sales of current for light, yet this is very improbable. It is possible, for instance, that an improvement to say fifty candle-power per watt would affect the central station lighting business, and would be as unpleasant to the central lighting stations as the railroads once were to the stage coaches. However, the final result will be the same whatever the central station does, and in my opinion the final result will actually be a very large increase of business. Any improvement in illuminants will bring in at least some competitive business. For instance, in Boston the sales of electricity amount to about three and one-half million dollars per year, and the sales of gas to about three million. Much of both of these is for power and heat, but even assuming that half of the gas sold is for lighting purposes, this leaves a possible competitive field open to the new illuminants amounting to one and one-half million dollars, besides the competition with oil lighting. This should mean an income for electricity of two to three million dollars a year, since customers will pay from twenty-five per cent to 100 per cent more for electricity than for gas, on account of the incidental advantage due to electricity, such as savings in decorations, wall papers, ventilation, etc.

In addition to the competitive field there are great latent possibilities. Many customers will pay $5 a month for a certain number of units of light. They will not pay $10 for double the number of units, but they will pay, say, $10 for triple or quadruple the number of units of light. Hence, while too great an improvement in illuminants may cut down the sales of electricity, there is an intermediate point where the improvement may actually increase the sales, and the improvements that are now apparently coming are, in my opinion, about this point. An improvement from one-third of a candle per watt to one candle per watt, such as is now in sight, will, in my opinion, ultimately increase the sales of electricity, and it will not be until we get to three or four candles per watt that the improvements in illuminants will cut down the sales of electricity.

In any case the final result will be the same whatever the central station does, and the central station should not attempt to interfere with the final result any more than the hackmen of the city should be allowed to force the railroads to have several stations instead of a union station.

Although the final result will be the same, whatever the central station does, yet the immediate result to the central station that supplies free lamp renewals is a very important one.

If the central station is supplying free lamp renewals and adopts the new illuminants, the immediate effect will be to give the customers more light in proportion to the money they pay; and this may either cause an immediate fall in income, followed, possibly, by an increase, or the central station may use its influence so that from the start the sales of current will remain the same or increase, while the light received by the customer shows a much greater increase.

This is the candle-power question. To-day, or rather yesterday, the central station supplied a lamp giving sixteen candle-power for fifty watts. If, on the introduction of the tungsten and tantalum lamps, they give sixteen candle-power for twenty watts, the immediate effect would be a very considerable falling off in income, and the falling off in income would be much greater than the falling off of expense, since every central station has a large amount of fixed expenses that is not affected by the immediate use of current.

If this were a free country and there were no socialists, a central station might wisely risk the temporary loss in income, looking to its future profits to make up for the loss, but if in this country the central station pays no dividends for one or more years, this is seldom or never taken into consideration in the future when the question of reducing its prices comes in; hence the central station, or rather the people who have been frugal enough to save the money that built the central station, must plan to earn their dividend each year, and can not risk losing it for even a short period.

Even without this consideration, if we assume that the future result of the new illuminants is to give the public much more light for the same or more electricity than at present, then the central station may properly attempt to reach this good result at once and instead of giving a sixteen-candle-power, twenty-watt lamp in place of its present lamps, it may offer its customers a forty-candle-power, fifty-watt lamp at the start.

It is true that very often a forty-candle-power, fifty-watt lamp will let a customer use two forty-candle-power lamps where he now uses five sixteen-candle-power lamps, but the public is less apt to cut down its supply of current if the central station supplies lamps of the same wattage as before, and hence it is to the advantage of both the public and the central station that the first move in the adoption of the new illuminants should be in the direction of the lamps of the same wattage as now, and of much greater candle-power.

Another important part of the central station view of the question is on the cost of renewals. If the cost of renewals is small in proportion to the total cost of electricity, then a slight variation in the cost of renewals is not important. For instance, to-day a central station, such as the Edison Electric Illuminating Company of Boston, supplies both eight and sixteen-candle-power lamps free. The cost of renewals of the eight-candle-power lamps is slightly more than of the sixteen-candle-power, but the difference is so slight that it can be disregarded.

One lamp company has just adopted the practice of proportioning its lamps so that the renewal cost per kilowatt-hour shall be the same for all sizes. Thus it supplies, we will say, a fifty-watt lamp whose proper life is 600 hours with a total consumption of thirty units, and if the cost of the lamp is fifteen cents, this makes the renewal cost one-half cent per unit. If the 100-watt lamp costs say twenty-five cents, it would then be so proportioned for voltage, etc., that during its economical life it would use fifty units. This practice is good, but unfortunately it does not cover the whole situation, since it is desirable that lighting circuits should be so arranged that small miscellaneous devices, such as cooking devices, fans, etc., should be supplied from the same sockets, and if the total cost of renewals becomes large in proportion to the cost of electricity, it is difficult to handle the question of free renewals.

The central station, therefore, much prefers that the new illuminants should be developed along the line of lamps whose renewal cost will be small in proportion to the cost of electricity. If, for instance, the price of electricity should get down to ten cents a unit on an average, and the renewal cost of the new illuminants should become four cents a unit, this would

force the central station to give up the policy of free renewals.

This situation has actually arisen to-day in the case of very large wholesale customers. For very large wholesale customers burning long hours, as for instance a department store whose lamps are kept going all day, the cost of electricity gets down in the neighborhood of three or four cents a unit, and for such business the central stations are in general giving up the policy of free renewals. Even in the case of these large customers, however, the fact that they have to pay for the lamps in a separate charge has caused them to use lamps that are not as economical as they should be.

In the case of small customers we have just had an instance in Boston where we put out the tantalum lamps at a renewal charge that not only made the cost per unit of light much less than for the ordinary carbon lamp, but even made the cost for the twenty-two-candle-power tantalum lamp much less per hour than for the sixteen-candle-power carbon lamp. In spite of this fact we find that the customer objects very much more to paying an occasional thirty or sixty cents for a new lamp than he objects to paying sixty cents or $1.00 more every month on the bill.

The flaming arc is another good illustration of this feature. The flaming arc for outdoor lighting gives tremendously more light in proportion to the total cost and maintenance. The maintenance cost, however, is so great that the central station can not possibly afford to include this in the price of current, so that the central stations have been forced to let the customer buy and maintain his own flaming arcs, and the results have been that the customer would rather pay a much greater total amount in the form of a bill for current than to pay the two charges for current and maintenance and trimming, even if the total of the two was less than the charge for the ordinary arcs alone.

Another part of the question that affects the immediate interests of the central station, but which will finally cancel out, is the question of investment and antiquation. Take for instance the small carbon arc lamp using carbons of five-sixteenths-inch diameter. This improves the light something like twenty-five per cent as compared with the arc lamp using one-half-inch carbons, but its adoption would involve purchasing a full supply of new lamps (since the old lamps using a large carbon can not be fitted over the small carbons). This would often be spoken of as involving scrapping of old lamps, but the correct point of view is from that of purchasing new lamps. Scrapping the old lamps is merely a book entry, while purchasing the new lamps takes the money out of the pockets of the people who have saved it up. If the small carbon lamps are going to be used for ten or fifteen years, then this will furnish time enough for the saving from them to make up for their cost; but if within two or three years the tungsten incandescent lamp is going to replace all our present arc lamps, then it is cheaper to wait for the tungsten than to purchase small carbon arc lamps and use them for two years only.

The Nernst lamp is to-day in much the same situation as the small carbon arc lamp. So far as we can tell, it is an improvement as compared with the ordinary incandescent lamp, but it costs $40 a kilowatt, and the question is whether it will save enough in the next year or two to make up for its investment cost when the tungsten lamp is finally put into service.

Another feature that the central station has to consider very carefully in regard to these new illuminants is their great multiplicity. To-day, for instance, the Edison Electric Illuminating Company of Boston, supplies, either free or at a nominal cost, over thirty kinds of incandescent lamps, six or eight kinds of arc lamps, and six or eight kinds of Nernst lamps. When the supply of any particular kind of renewal service is reasonably large, it can be handled with fairly good satisfaction, but we have the immediate problem before us to-day, for instance, in regard to the Nernst lamps in our outlying districts. If a customer in a small town, such for instance as Dover or Bellingham, wants one Nernst lamp or one arc lamp, we can not very well afford to send a man out there especially to trim and maintain one lamp. Hence, obviously, it is not enough in the case of the new illuminant to say that its cost of maintenance, or renewal cost, is small when it is done in quantities. It is necessary that the new illuminant of a special kind must be quickly adopted in large quantities if it is to be adopted by the central station.

Another question that affects the central station very closely is that of deliveries. Take for instance the "Gem" lamp. I should say that the central stations were very well satisfied to-day with this lamp and feel that its cost of renewal is such that they could replace the ordinary carbon with "Gems." But unfortunately the factories can not stop making ordinary lamps and go into making "Gem" lamps in one or two months, or even one or two years. At first the output of these lamps was five per cent of the total, to-day it is something like twenty-five per cent, and it will be a year or two before it is 100 per cent. While the central station may properly differentiate between different classes of customers, it must not discriminate. The central station, just like the telephone company, or the water works, may make one price for commercial business and another price for residential business, but it must not differentiate between Brown and Smith whose business and use of current are alike. Hence, the question is, "Who shall get the 'Gem' lamps, and who shall use the carbon lamps during the period of transition?" This has been solved in part by making a temporary extra charge for the "Gem" lamps. For instance, the large companies to-day that formerly renewed ordinary lamps free, still continue this practice, and they also renew "Gem" lamps, making an extra charge of five cents only as compared with the cost of the lamp of fifteen cents and twenty cents.

Apparently something like ten per cent to twenty per cent of the customers are willing to pay this five cents extra charge. The others prefer to pay twenty per cent to thirty per cent more on the bill for electricity. Theoretically, of course, we could reduce the charge to four cents, three cents, and so on down until the extra charge for the lamps became so small that every customer would rather have them, but below five cents it is a question whether there would be much difference in the demand.

This question can also be handled in the same way that the New York, New Haven & Hartford Railroad reduced its fare to two cents a mile, by picking out different divisions and saying frankly to everybody that they reduced the rate in one division, and that as quickly as it became possible to get out the schedules and do the clerical work, etc., the other divisions would likewise be benefited. This resulted in no trouble, as the customers of the railroad easily recognized the necessity.

In a similar way the central stations might pick out districts, or even classes of customers, and supply the "Gem" lamps free, say first to the churches, then say to municipal buildings, then say to

residences, and so on until all customers were receiving them.

The "Hylo" lamp, while not in one sense a new illuminant, yet might properly be considered among them. The "Hylo" lamp saves the customer a great deal in places where he simply wants a dim light, but it costs the customer considerably more when he is using the full candle-power. Hence, a customer who wants a little light for a considerable number of hours, and a good light for a short number of hours, gets it very much cheaper by the use of the "Hylo" lamp. The customer who now keeps in darkness when he would like a dim light will get his dim light from the "Hylo," paying for that, and also paying an extra cost for the time when he wants a good light.

It is a question whether it would not be cheaper for the customer to put in two sockets side by side, one with a small one or two-candle-power light, and the other with an ordinary lamp of much better efficiency than the "Hylo." The extra cost of the second socket should not be over seventy-five cents or $1, for which fifteen cents or twenty cents a year would be a fair allowance, and it would certainly seem as though this would be cheaper than to have the extra cost of the "Hylo."

All the new reflectors, such as Holophanes, etc., are in a sense really new illuminants. They result in giving more light where it is needed, for the same amount of electricity, or the same light for a less amount of electricity; hence, a good reflector is just as good as an improvement in the efficiency of the lamp, and should have the same final result in the central station's business. In this case, however, it is somewhat simpler to have the customer supply the reflector, and this has resulted in the kind of difficulties that the central stations are having from the new light being handled by the customer so far as reflectors are concerned. If the central station had in the past always supplied the reflectors to the lamps, then any improvements in the reflectors would have been just as difficult for the central station to handle as the tungsten, Nernst and other new lamps.

A very good summary of the difficulty that the central stations are having with the new illuminants is to call them growing pains. They are the difficulties that always arise when any new invention is made. If the customer supplies the lamps, as he does the reflectors, then the customer has the difficulties, and the central station waits for the final result, which may be either more business or less business. If, however, the central station supplies the lamps, it must handle the question so as to give as small a temporary loss of income as is possible, and so as to get the final result from the new illuminant as quickly as possible.

The central station must also handle the transfer from an old illuminant to a new, so as to avoid as far as possible any unnecessary scrapping of machinery. The central station should not adopt an improvement that will result in only five per cent or ten per cent saving if at the end of a year or two it expects to find still another improvement has made the change of the year before a serious net loss on account of the very high depreciation.

The central station difficulties are what might be called detail questions, but it does not help us in handling these details to expatiate on the great future savings. Wise handling of the transfer by the central station will mean a considerable difference to the public, and this difference will be important, even if the savings by the new illuminants are much more important.

If any one doubts the wisdom of having a central station try to handle all these difficulties of illumination and lamps and candle-power, etc., all that is necessary is to ask such person to look at the results in countries where the central station confines itself solely to the supply of electricity, and leaves the question of lamps and illumination to be handled by the individual customers.

New Power Plant of the Patapsco Electric and Manufacturing Company.

The Patapsco Electric and Manufacturing Company, Ilchester, Md., recently completed its new dam and power-house, which, as will be seen from the following description, furnished by the consulting engineers, Newton & Painter, and presented through the courtesy of Allis-Chalmers Company, of Milwaukee, whose generators are here installed, has many unique features. The power-house is placed inside of the dam, with the waste water passing over the top of it. The dam is situated on the Patapsco river about one-and-one-half miles below the company's other plant, or about three miles from Ellicott City and five miles from the western limits of Baltimore.

THE DAM OF THE PATAPSCO ELECTRIC AND MANUFACTURING COMPANY, ILCHESTER, MD.

The part of the dam used as a power-house is 108 feet long, fourteen feet high and twenty-seven feet wide, except at the buttresses, where it is eighteen feet. The power equipment consists of two thirty-two-inch horizontal turbine water-wheels running at 240 revolutions per minute, each direct connected to 300-kilowatt, 11,000-volt, three-phase, sixty-cycle Allis-Chalmers alternating-current generators. The voltage is unusual, but the transmission lines cover such a large territory that it was decided to use 11,000-volt generators in place of stepping the current up.

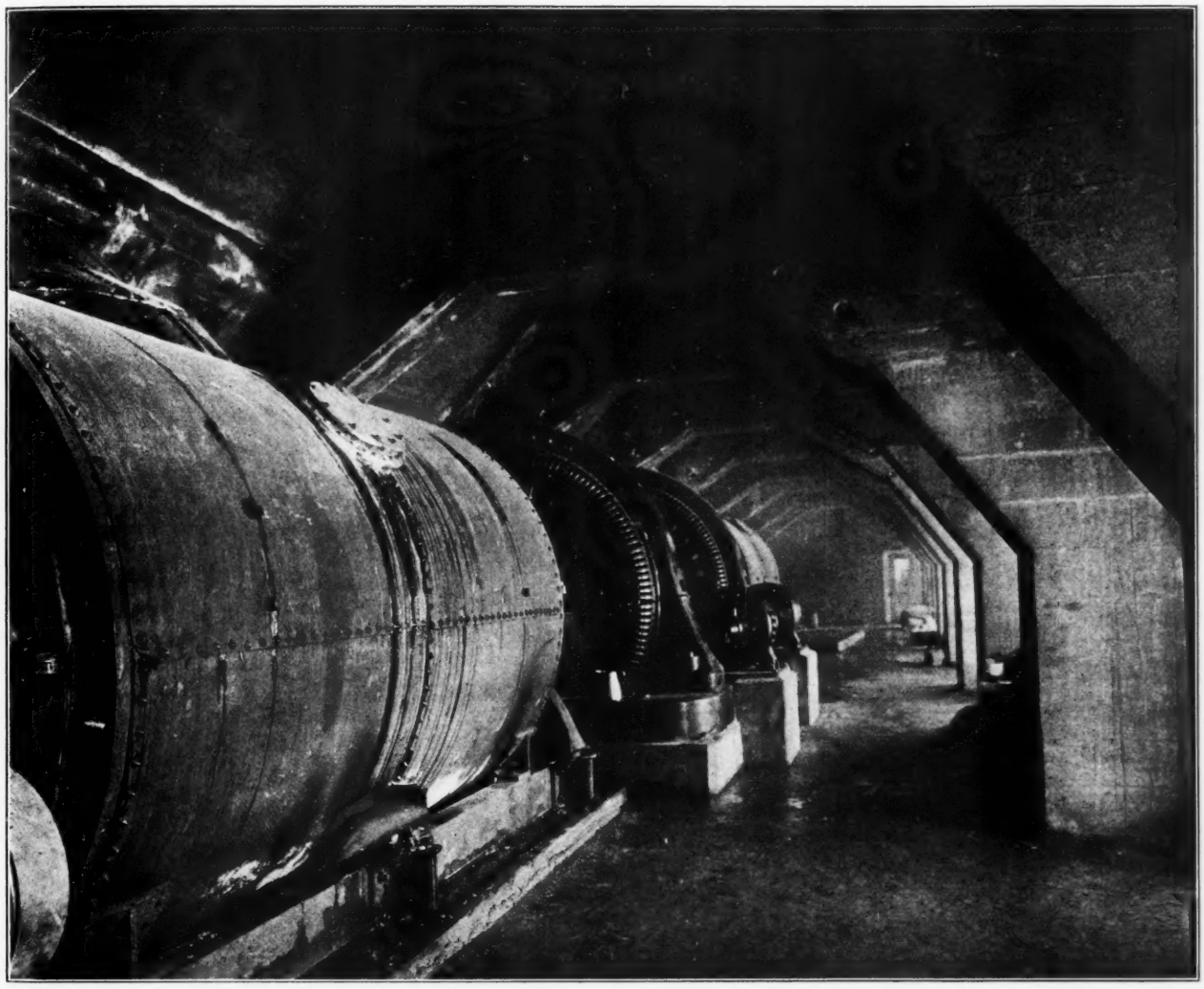
The turbines are fitted with governors,

so arranged that either will control both wheels when the generators are run in multiple. The generators have 125-volt belted exciters.

The switchboard, located at the end of the power-house, is ten feet eight inches long and eight feet three inches high, stands twelve feet from the wall, and is enclosed by grill work on each end. It is fitted with three voltmeters, two of each generator, so that it can be told at a glance if either phase is overloaded.

Polyphase indicating wattmeters have been provided, one for the street service and the other to indicate the total output; also two polyphase recording wattmeters, one for street service and the other for the commercial circuits. A polyphase curve-drawing wattmeter is further used for recording the total output of the plant.

At each end the buttresses and deck of the dam rise ten feet above the spillway, so as to allow for floods. The spillway is 168 feet long and arranged with anchor bolts, so that in case it should be found desirable, planks can be bolted to it sufficient to add two feet. The dam is built of reinforced concrete and the "deck" is supported by nineteen buttresses eighteen inches thick, which are spaced twelve feet



THE WHEEL HOUSE AND DYNAMO ROOM OF THE PATAPSCO ELECTRIC AND MANUFACTURING COMPANY, ILCHESTER, MD.

which are connected directly with two phases (at bus-bars) and the other through plugs, so that the other phase of either generator can be read. A synchroscope is placed under the voltmeters, all of which are mounted on swinging brackets attached to the end of the board. As the exciters are arranged to be operated in multiple, a regulator is used for controlling the voltage of the generators. Three ammeters have been provided for The leads to the generators and commercial and street feeders are fitted with distant-control oil circuit-breakers with disconnecting switches. The breakers for generators have time-limit relays, so in case of trouble on the outside feeders, they will not be thrown before the others.

The dam has a length of 220 feet, and is forty feet nine inches wide at its base. Its height from the normal tail waters to the spillway is twenty-six feet six inches. centres. The deck of the dam is eighteen inches thick at the bottom and tapers to ten inches at the top.

The part of the dam used for housing the plant is fitted with a false ceiling hung five feet from the inside so as to protect the apparatus from any water that might seep through the deck. The ceiling slopes until it reaches the vertical sides, forming the power-house. The side next to the tail waters is fitted with win-

dows. These windows furnish plenty of light, even when the water is flowing over the dam two feet deep. The part of the dam not protected by the false ceiling is comparatively dry, as very little water gathers on the inside of the deck, and what does collect there follows down the concrete deck until it reaches the drain at the bottom. The water for operating the turbines is taken through the deck five feet six inches below the crest of the spillway, which helps to keep the trash racks clear of driftwood, etc. Each trash rack is ten feet six inches and the flumes to turbines seven feet in diameter. Two waste gates are placed near the bottom of the dam, the water passing under the floor.

The waste water going over the dam is carried on the incline of the spillway to within sixteen feet of the tail water. This incline causes the water to fall about ten feet from the side of the dam, and, as the river bed is quite rocky at this point, the bottom is not pitted to any great extent.

The dam backs the water up three-quarters of a mile, with an average width of about 500 feet, to the tail waters of a cotton mill located at Ilchester.

The plant will supply current for both power and lighting. At present Ellicott City, Catonsville, Irvington, Carroll, Halethrop, Arbutus, St. Denis, Elkridge and a part of west Baltimore are being supplied from the other plant, the territory covered being about six by ten miles. There is a large day load, as about 250-horse-power in motors are supplied at different points. As soon as the new plant is in operation, it is intended to extend the lines to West Arlington and Mount Washington, about fourteen miles.

SEASONING OF TELEPHONE AND TELEGRAPH POLES.[1]

BY HENRY GRINNELL.

The scarcity of timber suitable for telephone and telegraph poles has of late assumed serious proportions. To users of poles, therefore, the question of how best to meet this situation is of first importance. Latest reports of the Census Office show that there were in operation in 1902 approximately 700,000 miles of pole line. Subsequent additions, however, together with certain railroad pole lines not reported, would enlarge this figure. It is safe to assume that there are in operation at present fully 800,000 miles of line. The average line contains about forty poles per mile, so that there are approximately 32,000,000 poles in use. Assuming that the average life of a pole is twelve years, it follows that for the maintenance of the lines now in operation there are needed each year more than 2,650,000 poles. Such an enormous demand must soon deplete the available supply. This is fully recognized by the different companies.

The experiments which are here described were conducted in cooperation with the American Telephone and Telegraph Company, and are among a number carried on by the Forest Service to determine the best means of prolonging the length of service of poles and other timbers, to the end that the number required each year for repair and maintenance may be reduced and the overcutting of the forest checked.

The questions involved in experiments to prolong the length of service of timbers fall naturally into two groups: (*a*) those which pertain to the rate of seasoning and (*b*) those which pertain to the preservative treatment and durability. The present circular deals only with those forming the first group. Those taken up are:

1. At what rate does seasoning progress in telephone poles?
2. Does the time of year when timber is cut affect its seasoning?
3. Does the time of year when timber is cut affect its specific gravity?
4. How much shrinkage occurs in air-seasoning?
5. What are the causes of the checking of poles during air-seasoning?
6. What is the best season for cutting poles?

Experiment stations were established at Dover, N. J., Thorndale, Pa., Pisgah, N. C., and Wilmington, N. C. As a part of the terms of cooperation, the American Telephone and Telegraph Company supplied during the experiments a fixed number of poles each month.

All poles were peeled immediately after being cut and were then hauled or rafted to the seasoning yard, where they were skidded in single tiers about two feet above ground.

As soon as possible after being placed on skids each pole was numbered, its weight taken, and its circumference at six feet and at thirty feet from the butt (or twenty-five feet in the case of the shorter poles) recorded. Weights and measurements were taken about once a month until the poles had practically ceased to lose weight. To determine the volume, weight per cubic foot, and specific gravity of the poles, a series of circumference measurements was made at the butt, at successive five-foot points, and at the top.

Although poles were cut in all twelve months of the year, it has been thought best in grouping the results to classify them as spring, summer, autumn, and winter cut, beginning at March 1. The tables show the average weight per cubic foot at the time of cutting and at subsequent seasoning intervals. The weight per cubic foot was found by dividing the weight of the average pole by its volume, which in turn was calculated from the average of the circumference measurements and from the length. The weight of the average pole at each seasoning stage may be found from the tables by multiplying the weight per cubic foot at the

TABLE I.

WEIGHT AND PERCENTAGE OF MOISTURE OF WHITE CEDAR POLES AT WILMINGTON, N. C., BASED ON 600 POLES.

Duration of Seasoning. Months.	Spring Cut.		Summer Cut.		Autumn Cut.		Winter Cut.	
	Weight per Cubic Foot. Pounds.	Moisture Content.[1] Per Cent of Dry Weight.	Weight per Cubic Foot. Pounds.	Moisture Content.[1] Per Cent of Dry Weight.	Weight per Cubic Foot. Pounds.	Moisture Content.[1] Per Cent of Dry Weight.	Weight per Cubic Foot. Pounds.	Moisture Content.[1] Per Cent of Dry Weight.
0	34.8	68	35.6	77	38.7	87	38.9	88
1	27.7	34	28.5	38	29.5	43	29.9	44
2	26.3	27	26.8	29	27.9	35	28.3	37
3	25.9	25	26.5	28	27.7	34	26.7	29
4	25.7	24	26.5	28	27.5	33	26.5	28
5	25.6	24	26.7	29	27.2	31	26.0	26
6	25.5	23	26.8	29	26.7	29	25.7	24
7	25.4	23	27.0	30	26.5	28	25.6	24
8	25.4	23	26.9	30	26.2	27	25.6	24
9	25.3	22	26.7	29	26.0	26	25.6	24
10	25.0	21	26.7	29	25.9	25	25.5	23
11	....	..	26.6	29	25.7	24	25.5	23
12	....	..	26.5	28	25.7	24	25.5	23
13	....	..	26.4	28	25.7	24	25.5	23
14	....	..	26.2	27	25.7	24	....	..
15	....	..	26.2	27	25.7	24	....	..
16	....	..	26.1	26	25.8	25	....	..
17	....	..	26.0	26	....	..	....	..

[1] Dry weight, according to Sharpless (Vol. IX, Tenth Census), is 20.7 per cubic foot.
The average volume of thirty-foot poles was 20.76 cubic feet, and of twenty-five-foot poles, 14.53 feet.

[1] From a circular of the United States Department of Agriculture, Forest Service.

desired time by the volume of the pole. The dry weights of cedar and chestnut wood used in the computations are those given by Sharples, in Volume IX, Tenth Census.

CEDAR POLES.

Tables I and II show the results of seasoning cedar poles from ten to seventeen months at Wilmington, N. C. Table I gives the weight per cubic foot and the percentage of moisture at various stages of seasoning of the average pole in each seasons's cut, assuming the dry weights of the wood to be 20.7 pounds per cubic foot. Since these poles had been in water for varying lengths of time before a weighing could be obtained, the weights may not correspond with those which would have been obtained starting with green wood.

From Table I it is evident that poles cut in autumn and winter weighed more per cubic foot when they came out of the water than those cut in spring and summer, and thus had to lose more water before reaching dryness. The table also shows that spring-cut wood continued lightest as long as weighing was continued. At the end of six months, however, the difference between the spring and winter cut is insignificant. In a carload of poles it would amount to only about 250 pounds.

Table II gives for the average pole cut in each of the four seasons the loss in percentage of the original weight at different periods of seasoning.

Table II is based on the original weight, and, unlike Table I, does not consider the dry weight of the wood. There is, therefore, a variation between the two tables in the relationship between the seasons of cutting and seasoning. While the winter-cut poles contain a greater amount of water at first, they season most rapidly and regularly after the first month and show increased loss of moisture each month until practically air dry. In the autumn and spring cuts the drying is continuous, but less regular, while in the summer cut, after three months, an increase in water content begins, and continues till about the ninth month.

Tables I and II show, then, that poles cut in spring contained less moisture than those cut at other seasons and continued lighter throughout. Winter-cut poles, although heavier when green, dried out faster than those cut in other seasons, but never caught up with the spring-cut poles. Summer-cut poles dried out rapidly for the first few months, but drying ceased with the approach of winter and the weight was not further reduced until the following spring.

The following statement shows, for conditions corresponding to those of the experiment, the length of time poles cut in the different seasons should be held before shipment to secure the lowest freight charges and at the same time minimize insurance and storage charges:

	Months.
Winter cut	4 to 6
Autumn cut	7 to 9
Spring cut	3 to 5
Summer cut	2 to 4

Air-dry weight of cedar is from sixty-five to seventy per cent of green weight, and an air-dry cedar pole contains about twenty per cent of moisture.

CHESTNUT POLES.

The poles at Thorndale were cut from younger trees than were those at Dover, and in consequence their weight per cubic foot of wood is considerably greater. In this case the weight of the green wood was greatest in summer. Spring, winter, and autumn followed in the order named. The seasons' cuts, arranged in the order of their respective moisture contents, show that for seasoning periods of three months or less spring was the best time to cut, summer, autumn, and winter following in the order named. For periods of twelve months or over, however, the order is winter, autumn, spring, and summer.

Winter-cut poles at Dover weighed more per cubic foot when green than other seasons' cuts. Summer was next heaviest, and spring and autumn were lightest. Arranged in the order of lowest moisture content, the seasons' cuts were as follows:

When green: {spring / autumn} summer, winter.

At 3 months: spring, summer, autumn, winter.

At 6 months: spring, winter {autumn. / summer.}

TABLE II.

LOSS OF FIRST WEIGHT OF WHITE CEDAR POLES AT WILMINGTON, N. C.

Duration of Seasoning. Months.	Loss of First Weight. Spring Cut. Per Cent.	Summer Cut. Per Cent.	Autumn Cut. Per Cent.	Winter Cut. Per Cent.
1	20	22	24	23
2	24	27	28	27
3	26	28	28	31
4	26	28	29	32
5	26	27	30	33
6	26	27	31	34
7	27	26	32	34
8	27	27	32	34
9	27	27	33	34
10	28	27	33	34
11	..	27	34	34
12	..	28	34	34
13	..	28	34	34
14	..	28	34	..
15	..	28	34	..
16	..	29	33	..
17	..	29	..	..

TABLE III.

WEIGHT AND PERCENTAGE OF MOISTURE OF CHESTNUT POLES AT DOVER, N. J., BASED ON 400 POLES—VOLUME, 22 CUBIC FEET.

Duration of Seasoning. Months.	Spring Cut. Weight per Cubic Foot. Pounds.	Spring Cut. Moisture Content. Per Cent of Dry Weight.	Summer Cut. Weight per Cubic Foot. Pounds.	Summer Cut. Moisture Content. Per Cent of Dry Weight.	Autumn Cut. Weight per Cubic Foot. Pounds.	Autumn Cut. Moisture Content. Per Cent of Dry Weight.	Winter Cut. Weight per Cubic Foot. Pounds.	Winter Cut. Moisture Content. Per Cent of Dry Weight.
0	50.8	81	51.5	83	50.8	81	51.8	85
1	49.0	75	48.8	74	48.4	72	50.8	81
2	47.5	69	47.4	69	47.2	68	49.8	77
3	46.5	66	46.8	67	47.0	67	48.7	73
4	46.0	64	46.6	66	46.8	67	47.5	69
5	45.5	62	46.4	65	46.6	66	46.3	65
6	45.1	61	46.2	65	46.2	65	45.3	61
7	44.5	59	46.1	64	45.5	62	44.5	59
8	....	..	45.7	63	44.7	59	44.1	57
9	....	..	45.0	60	43.9	56	43.8	56
10	....	..	44.0	57	43.2	54	43.2	54
11	....	..	43.4	55	42.8	52	....	..
12	....	..	43.0	53	42.5	51	....	..
13	....	..	42.7	52	42.2	50	....	..
14	....	..	42.4	51	....	..	....	..

At 7 months: { winter / spring } autumn, summer.

At Pisgah, winter-cut wood was considerably heavier than that cut at any other season, and, save in a single case, at no time did it reach the dryness of the other cuts. Considering only the amount of moisture, summer here appears to be the best cutting season. Spring, autumn, and winter follow in the order named.

Tables III, IV and V are derived from data obtained on chestnut poles at the three stations mentioned. They give for the average pole in each season's cut, at various stages of seasoning, the volume and weight in pounds per cubic foot and moisture content in per cent of the dry weight. The dry weight of chestnut wood is assumed to be 28.07 pounds per cubic foot, which is the figure given by Sharpless, in Volume IX, Tenth Census.

Table VI is based upon original weight and does not consider the air-dry condition of the timber. Like Table II, it is mainly valuable to the shipper in showing what reduction in weight may be looked for by holding poles cut in any season.

It will be understood that this table does not serve as a basis for comparison of poles cut at different seasons, since in this case the practical consideration is not the percentage of the original weight lost, but the actual weight reached, which was shown in Tables III, IV and V.

SPECIFIC GRAVITY OF WOOD.

While there is but little, if any, difference in the specific gravity of pure wood substance or cellulose, regardless of the kind of tree, the specific gravity of wood as found in the tree varies considerably.

The following figures were obtained from the green chestnut poles cut at the three stations at different seasons:

Season of Cutting.	Specific Gravity.
Winter	0.8627
Spring, Summer	0.8509
Autumn	0.8467

Shrinkage in wood may be distinguished as longitudinal, radial, and tangential. Longitudinal shrinkage (in the direction of the length of the fibers) is practically inappreciable; radial shrinkage (in the direction of the radius) is from four to six per cent; and tangential shrinkage (in the direction of the circumference) is about double the radial. In round timbers, such as telephone poles, shrinkage can best be determined by measuring the circumference.

From thousands of measurements made on telephone poles during this experiment, it was found that shrinkage was so slight as to be almost negligible.

Table VII gives the circumference at the six-foot and thirty-foot points for all the chestnut poles, and also the per cent of shrinkage at the end of twelve months. From this table it is evident that the maximum shrinkage was less than one per cent, and that the average was but about 0.5 per cent for the butt and 0.6 per cent for the top.

CHECKING.

All wood when undergoing a seasoning process, either natural (by air) or mechanical (by steam, kiln-drying, etc.), checks or splits more or less. This is due to the uneven drying out of the wood and the consequent strains exerted in opposite directions by the wood fibers in shrinking. There is more checking in the wood of broadleaf trees than in that of coniferous trees, more in sapwood than in heartwood, and more in summer wood than in spring wood. Inasmuch as under normal conditions of weather water evaporates less rapidly during early seasoning in winter, wood cut in autumn and early winter is considered less subject to checking than that cut in spring and summer. Rapid seasoning, except after wood is soaked or steamed, almost invariably results in more or less serious checking.

TABLE IV.

WEIGHT AND PERCENTAGE OF MOISTURE OF CHESTNUT POLES AT THORNDALE, PA., BASED ON 600 POLES.

Duration of Seasoning. Months.	Spring Cut (Volume, 20 Cubic Feet).		Summer Cut (Volume, 21 Cubic Feet).		Autumn Cut (Volume, 20 Cubic Feet).		Winter Cut (Volume, 20 Cubic Feet).	
	Weight per Cubic Foot. Pounds.	Moisture Content. Per Cent.	Weight per Cubic Foot. Pounds.	Moisture Content. Per Cent.	Weight per Cubic Foot. Pounds.	Moisture Content. Per Cent.	Weight per Cubic Foot. Pounds.	Moisture Content. Per Cent.
0	53.0	89	54.0	92	52.7	88	52.9	88
1	50.1	78	50.1	78	50.5	80	51.7	84
2	47.9	71	48.2	72	49.3	76	50.4	80
3	46.4	65	47.4	69	48.8	74	49.1	75
4	45.4	62	47.1	68	48.6	73	47.6	70
5	44.8	60	46.8	67	47.9	71	46.3	65
6	44.4	58	46.7	66	46.9	67	45.1	61
7	43.9	56	46.4	65	45.7	63	44.3	58
8	43.6	55	46.1	64	44.8	60	43.6	55
9	43.6	55	45.7	63	44.1	57	42.9	53
10	43-6	55	45.2	61	43.8	56	42.4	51
11	42.4	51	44.7	59	43.2	54	42.0	50
12	43.0	53	44.2	57	42.5	51	41.8	49
13	42.5	51	43.7	56	41.8	49	41.6	48
14	42.3	51	43.3	54	41.6	48	41.5	48
15	42.1	50	42.9	53	41.7	49	41.5	48
17	41.8	49	42.5	51	41.9	49	41.5	48
17⅓	41.8	49	42.4	51	41.8	49	41.5	48
19	41.5	48	42.3	51	41.8	49	....	..
20	41.3	47	42.1	50	42.2	50	....	..
21	41.0	46	41.7	49	....	..	....	..
23⅓	40.7	45	41.3	47	....	..	....	..

TABLE V.

SEASONING OF CHESTNUT POLES AT PISGAH, N. C., BASED ON 600 POLES.

Duration of Seasoning. Months.	Spring Cut.		Summer Cut.		Autumn Cut.		Winter Cut.	
	Weight per Cubic Foot. Pounds.	Moisture Content. Per Cent.	Weight per Cubic Foot. Pounds.	Moisture Content. Per Cent.	Weight per Cubic Foot. Pounds.	Moisture Content. Per Cent.	Weight per Cubic Foot. Pounds.	Moisture Content. Per Cent.
0	55.2	97	53.5	91	54.7	95	56.5	101
1	52.3	86	50.6	80	51.7	84	54.3	93
2	50.2	79	48.3	72	50.3	79	52.7	88
3	49.1	75	47.0	67	49.9	78	51.5	83
4	48.4	72	46.3	65	49.6	77	50.7	81
5	48.1	71	46.0	64	49.0	75	49.8	77
6	47.7	70	45.8	63	48.8	74	49.2	75
7	46.8	67	45.7	63	48.3	72	48.3	72
8	....	..	45.7	63	47.3	69	47.7	70
9	....	..	45.3	61	46.4	65	47.5	69
10	....	..	44.8	60	45.8	63	47.2	68
11	....	..	43.8	56	45.5	62	....	..
12	....	..	43.5	55	44.8	60	....	..
13	....	..	43.3	54	....	..	....	..
14	....	..	43.3	54	....	..	....	..
15	....	..	43.2	54	....	..	....	..

The average volume of thirty-foot poles was 21.12 cubic feet, and of twenty-five foot poles, 14.70 cubic feet.

The worst checking during seasoning experiments occurred at the Pisgah, N. C., station, where the poles were cut from comparatively young, rapid-growing trees. The trees were felled with axes and the chopping was carelessly done, so that in many cases the butts and tops were somewhat ragged and at times split. During seasoning, especially in summer, many of these poles checked and split badly at the butt and top, and in some cases pieces of wood of a width of several inches and of a depth of three to six annual rings curled up from the ends of the poles for a distance of several feet. Such pieces or slabs separated along an annual ring from the remainder of the pole, the point of separation being between the summer wood of one year's ring and the spring wood of the next. Had these poles been more carefully chopped or sawed the checking would probably have been slight.

TABLE VI.

LOSS OF FIRST WEIGHT OF CHESTNUT POLES CUT AT THREE SEASONING STATIONS.

Duration of Seasoning. Months.	Dover, N. J.				Thorndale, Pa.				Pisgah, N. C.			
	Spring Cut. Per Cent.	Summer Cut. Per Cent.	Autumn Cut. Per Cent.	Winter Cut. Per Cent.	Spring Cut. Per Cent.	Summer Cut. Per Cent.	Autumn Cut. Per Cent.	Winter Cut. Per Cent.	Spring Cut. Per Cent.	Summer Cut. Per Cent.	Autumn Cut. Per Cent.	Winter Cut. Per Cent.
1	4	5	5	2	5	7	4	2	5	5	5	4
2	6	8	7	4	10	11	6	5	9	10	8	7
3	8	9	7	6	12	12	7	7	11	12	9	9
4	9	10	8	8	14	13	8	10	12	13	9	10
5	10	10	8	11	15	13	9	12	13	14	10	12
6	11	10	9	13	16	14	11	15	14	14	11	13
6½	12	10	10	14	17	14	13	16	15	14	12	14
7	12	10	10	14	17	14	13	16	..	15	12	15
8	..	11	12	15	18	15	15	18	..	15	14	16
9	..	13	14	15	18	15	16	18	..	15	15	16
10	..	15	15	17	18	16	17	19	..	16	16	16
11	..	16	16	..	20	17	18	20	..	18	17	..
12	..	17	16	..	19	18	19	21	..	19	18	..
13	..	17	17	..	20	19	21	21	..	19	..	..
14	..	18	..	..	20	20	21	21	..	19	..	..
14½	..	..	..	..	21	20	21	22	..	19	..	..
15	..	..	..	..	21	21	21	22	..	..	..	..
17	..	..	..	..	21	21	21	22	..	..	..	..
17½	..	..	..	..	21	21	21	22	..	..	..	..
19	..	..	..	..	22	22	21	..	..	..	..	..
20	..	..	..	..	22	22	20	..	..	..	..	..
21	..	..	..	..	23	23	..	..	..	..	..	..
23½	..	..	..	..	23	24	..	..	..	..	..	..

PRACTICAL ADVANTAGES OF WINTER CUTTING.

Winter cutting of poles has long been the general rule, since conditions continue to make it the best and cheapest season for the logger. Moreover, sap contains fewer nitrogenous substances in winter than at other seasons, and since fungi obtain much of their food from these substances winter-cut timber is least liable to attack from this source. Nor does the harder and denser wood found in summer and early autumn afford fungi as good a chance to lodge and develop as the undeveloped wood, immediately under the bark, which forms in spring and early summer. Again, winter-cut poles season more gradually, and at that time of the year the wood fibers shrink more uniformly, and checking is less serious.

Winter at the experiment stations where chestnut was cut is usually cold, with more or less snow, while summer is warm and comparatively dry. The effect of such a climate upon the seasoning of poles is that from the time of cutting until approximately air-dry winter-cut poles lose water steadily; poles cut in autumn pass, during winter, through a period of comparatively slow seasoning, while spring and summer-cut poles are completely stopped in their seasoning during cold weather and frequently even absorb moisture.

Though in nearly all cases winter-cut wood is heavier than wood cut at other seasons, yet after six or eight months' seasoning under ordinary climatic conditions it so nearly approaches the weight of the lightest that the difference in shipping weight is practically negligible.

In short, seasoning does not in itself, at least under the conditions which accompanied these experiments, furnish a conclusive argument for cutting in any one season, so that the practical considerations in favor of winter cutting are of determining importance.

TABLE VII.

SHRINKAGE OF CHESTNUT POLES.

Circumference Class. Inches.	When Green.		After One Month.		After Three Months.		After Six Months.		After Twelve Months.		After Twelve Months.	
	Butt. Inches.	Top. Inches.	Butt. Inches.	Top. Inches.	Butt. Inches.	Top. Inches.	Butt. Inches.	Top. Inches.	Butt. Inches.	Top. Inches.	Butt. Per Cent.	Top. Per Cent.
36 ...	36.05	26.81	36.01	26.77	35.95	26.72	35.90	26.68	35.87	26.67	0.50	0.52
37 ...	36.99	26.84	36.95	26.81	36.89	26.75	36.83	26.70	36.79	26.66	0.54	0.67
38 ...	37.92	27.39	37.90	27.36	37.82	27.31	37.75	27.28	37.73	27.22	0.50	0.62
39 ...	38.85	28.58	38.81	28.53	38.69	28.43	38.60	28.38	38.58	28.32	0.69	0.91
40 ...	40-31	30.28	40.31	30.28	40.31	30 28	40.25	30.21	40.13	30.19	0.69	0.63
41 ...	41.13	30.45	41.11	30.45	41.06	30.42	41.06	30.39	41.00	30.33	0.31	0.39

CONCLUSIONS.

Below is given a summary of conclusions, the number of each corresponding to that of the question which it answers.

1. This, the main question involved in the experiments, is answered in Tables I to VI, which show approximately the rate at which chestnut and cedar poles may be expected to season under similar climatic conditions.

2. Winter-cut wood seasons more regularly than that cut at other seasons, but does not, for many months, at least, reach as low weight as spring-cut wood seasoned equally long.

3. In timber of approximately the same age and growth, that cut in winter will have the greatest specific gravity, and that cut in autumn the least.

4. The shrinkage of round timbers in air-seasoning is very slight and may be disregarded.

5. If poles are carefully cut, checking during air-seasoning is comparatively slight. If split or shaken in felling, however, serious checking may result.

6. From the standpoint of seasoning, spring and winter are the best times for cutting. Other considerations, such as custom, availability of labor, and susceptibility to decay, make winter cutting preferable.

The value of all the copper (exclusive of ores and matte) moved into and from the United States during the fiscal year ended June 30, 1907, reached $128,137,370, as compared with $103,038,932 in the previous year.

UPKEEP CHARGES ON LARGE ELECTRIC GENERATING SETS.[1]

BY HENRY ROBERT JOHN BURSTALL AND JOHN SOMERVILLE HIGHFIELD.

In the expense of generation of electricity it is necessary to include the cost of the repairs and maintenance of the plant; usually this is stated in terms of the units generated or sold, and in most cases the amount charged for repairs and maintenance is considered to vary with the number of units generated. This part of the question will be considered later. In the published accounts the sums charged to repairs and maintenance are the total for the whole of the plant and mains, and it is, in most cases, difficult to obtain a subdivision. As a general rule, and apart from accidents, etc., the repairs and maintenance on mains and switchboards may be taken as sensibly the same in most large systems, and as boiler and steam-pipe practice is now much standardized, the repairs and maintenance from the boilers to the engines should also be nearly the same in the larger stations. In the generating plant, however, the systems in use present wide differences in speed and type of prime mover and generator, and it is the object of this note to elicit as much information as possible as to the differences which may exist in the charges necessary to cover the repairs and maintenance of large electric generating sets.

It is evident, therefore, that a large portion of the upkeep charges is constant, independent of the units generated or hours run, and dependent approximately on the maximum output of the machines. The only part of the expense which will vary in any way with the hours of running will be the stores and materials expended. It would be of great interest if information could be obtained as to the number of men required for different stations of varying sizes.

Considering, now, the details of the upkeep charges, we have to separate the electric generators from the prime movers, and to point out where the charges may be expected to arise.

Electric Generators—Leaving out the charge necessary to provide against breakdown or burning out, which will vary with the pressure and system, the only true upkeep expenses are:

For direct-current machines, principally renewal of brushes and commutator repairs, which will vary greatly. If proper attention is given to providing the right quality of carbon in the brushes, and especially the right quality of mica in the commutators, the cost of upkeep of these is small.

For alternating-current machines the cost of upkeep is negligible.

Our experience of large alternating-current generators is that, in a properly constructed machine well looked after, the bearings may be taken to last as long as the machine, and that, in machines exceeding 500 kilowatts output, and working with a maximum pressure to earth not exceeding 4,000 volts, the risk of breakdown is very small; but with machines working at higher pressures than this, the risk, though still small, increases at a faster rate than the pressure. In connection with this we wish to express the opinion that at present it is impossible to construct a machine with closed slots which will work at a pressure of 10,000 volts to earth.

Steam Engines—With recipfocating engines the upkeep charges appear to be independent of the type and speed, and the risk of breakdown is now very small. With steam turbines the upkeep charges should be smaller still, but there is little information available; some of the earliest turbines which were put to work in London showed no appreciable wear after years of work. The breakdowns of large turbines have hitherto been more frequent and of greater magnitude than in reciprocating engines, although probably with improved design and methods of manufacture this state of affairs will be reversed.

The cost of upkeep of water turbines is almost entirely in the replacement of bucket-wheels, and depends largely on the quality of the water used; it has been found that, in addition to the buckets being worn on the front side by sand, etc., in the water, considerable corrosion takes place on the back, due to the oxygen in the water. The upkeep charges on water turbines will vary more with the hours run than for other types of plant, owing to the bucket wear. We have been fortunate in obtaining the actual upkeep charges for a water-driven station which has worked for a number of years.

Gas Engines—The figures available show that the parts which wear are the same as in a reciprocating steam engine, but that the upkeep costs are somewhat higher in some types of engines, owing to the complexity of the valve gear.

With large generating sets, the upkeep charges may be taken to depend mostly on the output of the set, and a small proportion of the total charges only vary with the units generated. Table I gives figures for some typical machinery, but these, of course, are not to be taken as averages. A comparatively large proportion of the upkeep charges are really for examination and overhaul, which should be done periodically, and bears no proportion at all to the hours of running; and it is to be remembered that it may cost several times as much to take down and reerect a machine as it does to effect the repairs necessary owing to wear. In our opinion, repairs and maintenance should be worked out on the normal power of the station, and not on the units generated, and should be compared on this basis. Any allowance for risk of breakdown, which is of the nature of insurance, would also naturally fall into the same category.

The cost of maintenance may therefore be divided, under two heads:

(1) Charges which may vary with the capacity of the plant, which are:

(*a*) Capital charges, in which may be included repair shops, tools, and possibly overhead travelers.

(*b*) Wages of workmen, including supervision.

(*c*) Painting and cleaning of engines, etc., and cost of all materials in connection therewith.

(*d*) Insurance.

(2) Charges which may vary with the hours run or units generated, and are:

Materials and wages for renewal of parts (piston rings, packings, bushes, brasses, etc., and dynamo brushes).

TABLE I.

MAINTENANCE COSTS OF STEAM AND WATER-DRIVEN ELECTRIC GENERATORS.

1. High-speed steam alternators, vertical compound engines.
   Load-factor, nineteen per cent.
   Maximum load on plant, 10,000 kilowatts.
   Output (average for three years), 16,000,000 kilowatt-hours.
   Size of each unit, 1,500 kilowatts to 3,000 kilowatts.
   Average cost of labor (over three years), $9,495 = $3,165 per annum.
   Average cost of material (over three years), $3,910 = $1,305 per annum.
   Standing charge for labor, $0.3175 per kilowatt-year.
   Running charge in cents per unit, 0.008.
2. High-speed direct-driven steam generators.
   Load-factor, thirty-eight per cent (over five years).
   Maximum load on plant, 755 kilowatts.
   Output average for five years, 2,500,000 kilowatt-hours.
   Size of each unit, 100 kilowatts to 300 kilowatts.

	Engines.	Generators.	Total.
Average cost of labor (over five years)....	$190	$25	$215
Average cost of material (over five years).....	155	50	205
Extra charges, average (over five years)	200	130	330
			$750

   Standing charge, including extras, $0.720 per kilowatt-year.
   Running charge in cents per unit, 0.0078.
   Extra charges include a broken crank-shaft and the rewinding of field coils on one machine.
3. Water-driven direct current generators.
   Load-factor, ninety per cent.
   Capacity of plant, 5,000 kilowatts (machine of old type).

	Cents per Kw.-Year.
Average cost of labor on repairs (for four years).....	8.68
Average cost of copper brushes.....	5.40
Average cost of renewal of mechanical parts.....	2.66
Average cost of renewal of armatures and commutators.....	20.60

   On two modern machines the repairs over two years are $0.50 per kilowatt-year for renewal of brushes.

[1] Paper read at the engineering conference of the Institute of Civil Engineers of Great Britain, June 19.

Boiler, Engine and Generator Testing and Management—V.

By Charles L. Hubbard.

Valve-Setting.

THE object in setting the valves of an engine is to equalize as nearly as possible, admission, expansion, exhaust and compression for both ends of the cylinder. On account of the angularity of the connecting-rod it is impossible with an ordinary slide-valve to equalize all of these events for both the forward and return stroke. It is easy to set a valve so that any one event may be made to occur at similar points in each stroke. Thus the admission may be made equal for both ends of the cylinder, or the valve may be set to equalize the exhaust, and so on; but when it is set so that two like events will be equal for each stroke it does not follow that any other two like events will also be equal for both strokes.

In most high-speed engines fitted with shaft-governors the position of the eccentric, and hence the lead corresponding to the eccentric position, can not be changed, so that all that is required is to set the valve so that it travels equal distances on both sides of its central position.

There are many different kinds of valves, each requiring somewhat different treatment, but the general principles are much the same.

The method of setting a plain slide-valve will be given first, followed by brief descriptions of the methods to be employed in the case of direct and indirect piston valves, separate cut-off valves, and Corliss valves.

The first step in any case is to put the engine on its centres before setting the valve. This is done by turning the fly-wheel in its usual direction of rotation to a position where the piston has nearly completed the outward stroke, and make a mark "A" on the guide opposite some given point on the cross-head (see Fig. 1). Also make a mark with a centre punch on the frame of the engine near the crank disc or on the floor near the rim of the wheel as shown at "B." If the floor is of soft wood it is well to tack a piece of tin or zinc to it and make the prick mark "B" upon this. Next chalk the side of the rim and mark on it the arc "a a," which should be true with the centre of the shaft.

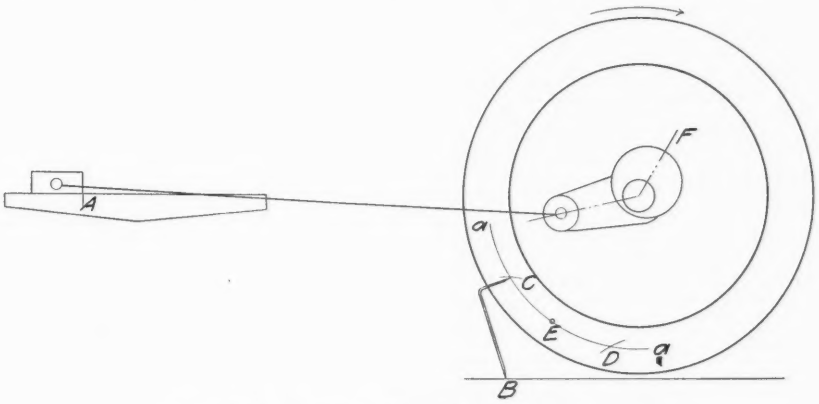


FIG. 1.—METHOD OF SETTING A PLAIN SLIDE-VALVE.

The slide-valve is so designed that the laps can not be altered without considerable labor, and the radius of the eccentric, which determines the travel of the valve is usually fixed.

The adjustable parts are commonly the length of the valve spindle and the angular advance of the eccentric. By lengthening or shortening the valve spindle, the valve is made to travel an equal distance on each side of the mid-position. Moving the eccentric on the shaft makes the action of the valve earlier or later as the angular advance is increased or decreased.

In setting valves of this type it is customary to give an equal travel in both directions from a central position. If the engine has a throttling governor so that the eccentric is adjustable upon the shaft, the lead may also be adjusted and made equal for both ends of the stroke.

This can be done with a pair of steel compasses, using the outer circumference of the rim as a guide, provided it has been trued in a lathe. With the punch mark "B" as a centre, describe an arc "C" on the rim with a piece of bent and sharpened wire of the form shown. Next turn the wheel forward in the direction it is to run, so that the crank will move to and beyond the dead centre and the given point on the cross-head has come back to the point "A" on the guide. If by any chance the cross-head should be run by this point, the wheel should be turned well back beyond the end of the stroke and again be brought carefully up to the desired position. This is to take up all lost motion due to any play or looseness at the bearings. Then with "B" as a centre make a second arc "D" with the scribe, and bisect the arc "CD" on the rim between the two short arcs "C" and "D," and turn the wheel until the new point "E" is at a distance from the prick mark "B," equal to the length of the bent wire or scribe. The engine is now on its centre. The wheel is next moved around so that the cross-head will be near the end of its stroke at the opposite end of the guide bar, and the operation just described is repeated.

The next step is to provide a small wooden wedge about three inches long, making the thicknesss of one end equal to about one-half the amount of lead it is intended to give the valve, and the other end about twice as thick as the intended lead. The wheel is then moved forward until the engine is placed upon its front dead centre as already described; the eccentric is loosened on the shaft and placed in such a position that its centre line ("F"—Fig. 1) will stand sufficiently in advance (in the direction in which the engine is to run) to let the front port open to the required amount of lead and then fasten it in place by means of the set screws. The amount of lead is then measured, when the eccentric is thus set, by chalking the faces of the wedge and inserting it in the opening or lead port, putting it between the edge of the valve and the edge of the port until it fits snugly, and then moving it sidewise slightly so as to leave a mark which will show how far it entered. The wheel is then moved forward until the engine is on the other dead centre, and the wedge is tried in the back port. If it enters the same distance as in the front port, the valve is correctly set; if the leads are found to be unequal, one-

half the error should be corrected by changing the length of the valve-rod, and the lead be brought back to the required amount by shifting the eccentric slightly upon the shaft.

The lead of stationary engines varies from zero to three-eighths of an inch, according to the style of the engine. An engine having high compression, that compresses the steam nearly to boiler pressure, will give good results with little or no lead.

If the ports are small, and the clearance large, there should be considerable lead in order to insure full initial pressure on the piston at the beginning of the stroke. Valves that open slowly require more lead than quick-acting valves.

When the engine is on a dead centre, the valve should be at its central position, and the axes or centre lines of the crank and eccentric should make an angle of ninety degrees. The angle through which the eccentric must be moved on the shaft to overcome the lap and bring the edge of the valve flush with the edge of the port, is called the *angular advance*. If it is desired to give the valve a certain lead at the beginning of the stroke, the eccentric must be advanced still more as already described. This additional advance is called the *angle* of *lead*.

The angle between the axes of the crank and eccentric is therefore equal to ninety degrees plus the angular advance plus the angle of lead. If there is too much difference in the work done by the forward and return stroke, the cut-off may be equalized as follows:

Place the engine on the dead centre, give the eccentric the required angular advance and the valve the proper lead. Move the engine forward until cut-off occurs, then measure the displacement of the cross-head from the beginning of the stroke. Continue moving the engine forward, until cut-off takes place on the return stroke, and measure the displacement of the cross-head from the beginning of the stroke to this point. In case the cut-off is earlier at the crank than at the head-end, the valve spindle is too short. Adjust the length of the spindle so that the inequality will be corrected. Now set the engine on the dead point again and give the valve the proper lead by means of the eccentric.

By repeating the process, making slight changes, the desired result will be obtained.

In setting the ordinary slide-valve, the cover of the steam-chest can be removed and the adjustments made by direct measurements of the port openings.

In the case of a piston-valve the bushings and valve are usually introduced from the end, in which case the port openings are not easily accessible, as will be seen by reference to Fig. 2, and *indirect* measurements must be resorted to. This method of valve setting was quite fully

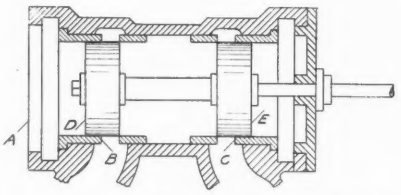


FIG. 2.—METHOD OF SETTING A PISTON-VALVE.

treated by Mr. John Alexander in *Science and Industry* some years ago, and, briefly described, is as follows:

In setting any valve it is essential to know the positions of the valve when it is just about to open the steam ports, that is, to know when the admission edges of the valve and the edges of the ports are in line with one another.

In Fig. 2 let B and C be the admission edges of the two steam ports, and D and E be the admission edges of the valve.

Then if we choose some well-defined surface or point of the steam chest from which measurements can be taken to the admission edges of the steam ports and the valve, as, for instance, the surface of the flange A which receives the bonnet or steam-chest cover, it is readily seen that the edges B and D will be in line when the measurement AD = AB. Having measured the distance DE and AC beforehand, a little reflection will show that C and E will be in line when the distance AD = (AC—DE). Then, if we so ad-

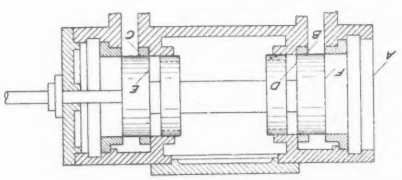


FIG. 3.—METHOD OF SETTING PISTON-VALVE OF THE INDIRECT TYPE.

just the length of the eccentric rod and the position of the eccentric that AD = AB, and AD = (AC—DE) for the two dead-centre positions of the crank, we know that the valve has been properly set, but gives no lead, and in order that it may have lead, the distance AD must equal AB + lead for one steam port, and AC — (DE + lead) for the other. From the above facts it is evident that the first step is to put the engine on one dead centre; then, if the eccentric is movable on the shaft place it as near its correct position as can be judged by mere inspection, and then set the valve so that it travels equally to both sides of its central position; in other words, obtain the correct length of the valve stem or eccentric rod, depending upon which is adjustable. Having obtained the correct length, shift the eccentric to obtain the lead. In most high-speed engines fitted with shaft governors the position of the eccentric, and hence the lead corresponding to the eccentric position can not be changed, so that all that is required is to set the valve so that it travels equal distances on both sides of its central position. In detail, the crank having been set on the dead centre nearest the valve, and the eccentric having been temporarily fastened in its trial position, move the valve by lengthening or shortening the stem or eccentric rod until AD = AB. Now put the crank on its opposite dead centre and measure AD again. As previously explained, if AD now equals AC — DE, the valve is centrally set, but without lead. This, however, may not occur once in a thousand times. Now suppose that instead of AD being equal to AC — DE it is less. Then we know that the edge E has traveled past the edge C, and that the steam port has opened a distance equal to the difference between AC — DE and the actual measurement AD.

This condition is due only to one cause, which is that the combined length of the valve stem and eccentric rod is too great. To obtain the correct length, shorten the actual length by one-half the difference between AC — DE and the actual measurement AD.

Suppose AD is found to be more than AC — DE. We can then readily see that the edge E has not reached the edge C by an amount equal to the difference between AC — DE and the actual measurement AD. This can only be due to the combined length of the valve stem and eccentric rod being too small, and to obtain the correct length, make the length greater by one-half the difference between AC — DE and AD. The valve having been centrally set, it now remains to shift the eccentric to obtain the required lead. The crank remaining on the dead centre furthest from the valve, measures AD. If AD does not equal AC — (DE + desired lead), shift the eccentric in the direction required by the design of the engine until AD = AC — (DE + desired lead).

Fig. 3 shows a valve of what is known

as the *indirect* type, that is, the steam is admitted past and cut-off by the *inside* edges of the valve, and the exhaust is opened and closed by the outside edges of the valve. In this case the inside of the valve is filled with live steam, while the outside of the valve is surrounded by the exhaust. Referring to Fig. 3, we can readily see that we can not take a direct measurement to the admission edges of the valve, but are forced to make measurements from some well-defined surface of the steam chest to some well-defined surface of the valve, and then make allowance for the distance of the admission edges from this accessible surface of the valve.

Suppose we choose the surfaces A and F as being most convenient. Then, first of all we must remove the valve from the chest and measure the dimensions FD and FE of the valve, and the distances AB and AC between the chosen surface of the steam chest and the admission edges of the ports. The valve having been replaced, it will be seen that the admission edges of the ports and the valve will be in line when AF = (AB — FD), and when AF = (AC—FE). For a given amount of lead AF should equal AB — (FD + lead) at the head end, and AC — (FE — lead) at the crank end.

To set the valve, put the crank on one dead centre, say the head end, and lengthen or shorten the combined length of the valve stem and eccentric rod until AF = (AB — FD). Now shift the crank to the other dead centre and measure AF again. If AF = (AC — FE), the valve is set central, but this condition must, of course, be reached by trial. If AF measures less than AC — FE, it shows the combined length of the valve stem and connecting-rod to be too great, and it must be shortened by an amount equal to half the difference between AF and AC — FE.

Conversely, if AF measures more than AC — FE, the length of valve stem and eccentric rod is too small, and must be increased by an amount equal to one-half the difference between the actual measurement AF and AC — FE. When this has been done, the valve is centrally set, and in the case of most shaft-governor engines the valve-setting has been completed. When the eccentric is movable, it remains to give the proper angular advance to the eccentric. The crank still being on the crank-end dead centre, turn the eccentric on the shaft in the direction required by the design of the engine until AF = AC — (FE — desired lead), and then fasten it there, thus completing the valve-setting.

(To be concluded.)

THE INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.

TWELFTH ANNUAL CONVENTION, NORFOLK, VA., AUGUST 7, 8 AND 9.

The twelfth annual convention of the International Association of Municipal Electricians was called to order by President T. C. O'Hearn in the City Hall of Norfolk, Va., at ten o'clock, August 7. President O'Hearn called upon Councilman J. S. Barron to assume the charge of the opening exercises. An address of welcome by the acting mayor, D. S. Burwell, assured the delegates of a generous entertainment, and he gave a brief history of the development of the city, assuring the delegates and guests of the pleasure it gave the citizens to entertain them.

J. B. Yeakle, of Baltimore, responded for the association, expressing the gratitude of the members for the cordial greeting and the many provisions for the entertainment of the members and guests. President O'Hearn then resumed the chair and delivered his address, urging all members to attend strictly to business during the sessions.

AFTERNOON SESSION.

On reassembling in the convention hall the meeting divided into sectional meetings, preparing the business to be handled in a concrete form for the general convention; these sectional meetings occupied the entire afternoon.

The evening was devoted to sight-seeing around the city.

SECOND DAY, AUGUST 8.

The first business was the report of A. S. Hatch, chairman of the electric light department, who said A. L. Pierce, of Wallingford, Ct., would read a paper entitled "Operation of a Municipal Electric Light Plant," the main feature of which was that a municipal plant to be successful must be conducted in the same manner as a private corporation, *i. e.*, the superintendent must be in absolute control, and the elimination of political influences must be complete.

C. S. Downs, of Altoona, Pa., read his paper entitled "Luminometer Methods of Testing Street Arc Lamps," the author claiming this method to be the fairest yet devised for both the companies and the public.

The discussion of these two papers consumed all the time of the morning, and the afternoon was given up to a trip by steamer around the bay through Hampton Roads, landing the party at the Jamestown Exposition grounds and thence by trolley cars to Ocean View. In the evening all went to the Ocean View Hotel where the annual banquet was served.

THIRD DAY, AUGUST 9.

The session was called to order at ten o'clock by the president. J. B. Yeakle explained the value of volt and ammeter tests for insulation of lines, describing some unique methods used in the Baltimore office.

The paper by Adam Bosch of Newark, N. J., entitled "Modern Fire Alarm Central Office" was read. This was a description of the central office recently installed by his city.

Walter M. Petty, borough electrician, Rutherford, N. J., presented a paper entitled "Modern Application of Storage Batteries," the author advocating a large capacity cell connected to the circuits in multiple rather than the greater number of smaller ones in series for each circuit.

The question, "What Efforts, If Any, Do The Various Cities Make To Control Street Railways" provoked a lively discussion, developing the fact that very little was done to control the companies.

The election of officers resulted as follows:

R. A. Smith, Norfolk, president.

J. B. Yeakle, Baltimore, first vice-president.

B. A. Blakey, Montgomery, second vice-president.

C. F. Gall, Louisville, third vice-president.

C. S. Downs, Altoona, fourth vice-president.

Frank P. Foster, Corning, secretary.

C. E. Diehl, Harrisburg, treasurer.

L. Gascoigne, T. C. O'Hearn, Cambridge; W. Y. Ellett, Elmira; Elmer G. Loomis, Allegheny; Wm. S. Devlin, New Castle; Clarence R. George, Houston; Wm. Crane, Erie; Jerry Murphy, Cleveland; James Grant, New Haven; executive committee.

A. L. W. Kittredge, New Haven, Oliver M. Schafer, Trenton, finance committee.

There was a spirited contest between the cities of Detroit, Mich., and Niagara Falls, N. Y., for the next convention, Detroit being finally selected for the meeting in 1908. The meeting then adjourned and the delegates and guests were taken in automobiles around the city on a sight-seeing trip.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Some Aspects of Electrical Development.

An analysis is given here by Charles F. Scott, of the reasons why the application of electricity leads to increased results or new methods in practically every field in which it is introduced. The manufacture or generation of power has been shown to be the fundamental element underlying the new epoch and the progress of modern times. When dependence was placed upon the engine alone there were certain limitations which were of necessity observed when the engine was directly connected to its load, it had to run at a certain speed and be placed within a short distance from it; subdivision and distribution of power was difficult. In other words either the engine must be brought to the work or the work to the engine. When the work to be done was scattered, separate power equipments were necessary. These limitations are removed by the electric system, in which power, generated in a suitably located central station, is distributed to many points of utilization, each in turn, suitably located for its peculiar purpose. There are no limitations of speed and the arrangement of the machinery becomes flexible. The result of this has been to develop large generators and engines for driving them and has led to a noteworthy advance in steam engineering, for not only were enormous power-houses constructed, but the development has been so radical, particularly with regard to the type of prime mover, that stations built a few years ago are already out of date. The steam turbine has brought about a revolution in generating station practice, and the advent of the large gas engine promises to bring about another. These developments have a reflex action on the electrical system for every advance in power generations make the electric motor available for a new service, the requirements of which are, at times, more severe than those of older applications, or which introduces new conditions that must be met. For example, the use of gas engines in rolling mills has been made possible by the adoption of the electric system, the gas engine itself being unsuitable for direct driving in such works, while to adopt the electric motor to driving mills it is necessary to meet more severe conditions than have ever been imposed. In the same way, the electric system has made available water power too inconveniently situated to be utilized before, and in the development of this power, a great advance in electrical apparatus and methods has taken place. One most striking example of this mutual development is the field of transportation. The subdivision of power made possible the application of small driving units for street cars, a service the steam engine had not successfully given. This application not only led to a wonderful development in traction methods, but to keep step with it the electrical designer has made corresponding progress in his machines, which progress has, in turn, lead to the introduction of the traction motor in still larger fields, and eventually even into competition with the steam locomotive itself. It is this feature which characterizes the electrical system. It is applied to improve old methods or to make possible new methods of working. It is not used for itself, but as a means to an end.—*Abstracted from the Journal of the Worcester Polytechnic Institute (Worcester, Mass.), June.*

Determination of the Temperature Characteristic of an Electrical Machine.

The usual method of rating electrical machines by the load which they will carry with a given rise in temperature makes necessary a temperature test under loaded conditions. This is usually known as the heat run, and time is required to make it. If the machine be large, the time it takes for it to come to a steady temperature is apt to be long. In this article, F. Loppé describes a method of determining the final temperature of any electrical machine, if observations be taken during the time it is heating. This method, of course, can be applied only to determine the ultimate temperature under steady load conditions. If, during the heat test of a machine, the curve showing the rise in temperature with time be plotted, and the tangent to this curve at the origin be drawn, the tangent of the angle thus made with the axis of abscissas is proportional to the rise in temperature which would take place if no heat were allowed to escape from the machine. This rise in temperature is then equal to the tangent of the angle mentioned multiplied by some constant. If another tangent be drawn to the heat curve at some other point, the tangent of the angle which this makes with the axis of abscissas is again proportional to the heat effect of the load on the machine at that particular time. The difference between these two heating effects is then equal to the cooling effect, due to radiation at the temperature of the last observation, and from it may be found the cooling effect per degree rise in temperature. Knowing this quantity, it is then easy to determine the final temperature of the machine, since it is that temperature at which the radiation from the machine at the rate just found will be equivalent to the heating effect as measured by the first observation. The method may be carried out graphically, and, when it is done, the final temperature of the machine is given by a simple geometrical ratio.—*Translated and abstracted from L'Industrie Electrique (Paris), July 25.*

Wireless Telegraphy During Daylight.

In this communication, R. A. Fessenden describes briefly the success which he has had in sending wireless telegraphic messages during the daytime by means of a different type of electrical impulse from that which he had previously employed. This impulse has made it possible to cut down the absorbing power of daylight to a small fraction of its previous amount. The system has been tried from Brant Rock, Mass., to the West Indies, the distance being approximately the same as that from Newfoundland to Ireland. The success is so noticeable that Professor Fessenden believes that transatlantic wireless telegraphy during daylight is assured. The new impulses are less efficient during night-time than the old ones, but they give results which are equally good by night and by day. A comparison between the effectiveness of transmission obtained through their use and the use of the older type is about as follows, the distance being from Brant Rock to Washington, D. C.: When the old impulse produces an effect equivalent

to 1,200 between the hours of 10 and 12 at night, the same impulse would give a strength of signal between 12 and 12.30 at noon of only thirty. The new impulse, under the same conditions, will produce an effect at the receiving station of about eighty between 10 and 12 at night, and of seventy-six between 12 and 12.30 at noon. The fact that the newer signals are weaker in daytime than the old is thought to be of no consequence, it being much more important that there should be no marked difference between the transmission during the daytime and at night. Rough measurements over long distances seem to show that the new type of impulse does fall off somewhat when transmitting 1,500 miles or more, but that the rate of falling off does not compare with that of the old type of impulse, so that the signals received are much stronger. The author has come to these conclusions, after experimenting with the new impulse over three months.—*Abstracted from the Electrician (London), July 26.*

The Munster-Schlucht Electric Railway.

A description is given here of an interesting electric road running from Munster to the Schlucht in Alsace which has recently been put into service. When the road was proposed, two alternative lines were considered, one an entirely adhesion railway, with maximum grades of eight per cent, while the other contained one section with a grade of twenty-two per cent on which a rack rail was necessitated, while the maximum on other parts of the road was five-and-one-half per cent. This route was more than two miles shorter than the other, and was adopted. The first one-and-three-quarter miles of the route out of Munster is along the main road. The line then leaves the road, but rejoins it after a short distance, the road at this point having been widened to accommodate the track. The route then follows the road until it reaches that section where the track is laid. This section is about one-and-one-quarter miles long, and the track extends beyond it about a mile farther. The total length of road is six-and-one-half miles. The station at Munster has an altitude of 1,250 feet. At the Schlucht, the altitude is 3,740 feet. Grooved girder rails are used in the towns and ordinary bull-headed rails for the rest of the line. Both the running rail and the rack rail are mounted on iron chairs, the top of the latter being about two inches above the head of the rail. The maximum pressure on the teeth of the rack is five-and-one-half tons from each of the two wheels which engage with it. Tangential pressure on the rack is taken in the usual way by concrete blocks. The generating station is at the end of the line at Munster, where there are two belt-driven, three-phase alternators, each rated at 200-kilovolt amperes, 7,000 volts, fifty cycles. This station also supplies a good deal of lighting, and some power, in the neighborhood of Munster. The power is taken to a substation near the upper end of the rack section, where there are two 100-kilowatt motor generator sets, which supply continuous current at 750 volts to the trolley wire. There is a buffer battery here of 390 cells, each with a rating of 960 ampere-hours, which operates in parallel with the motor generators. The overhead construction is partly of the span-wire and partly of the bracket-arm type. Two conductors are used, each nine millimeters in diameter; but there is no feed wire. The collectors on the cars are of the bow type, there being two collectors, each in contact with both trolley wires. The normal traffic in summer is nine trains a day, yet a fifteen-minute service can be maintained on special occasions. In winter, there are but five trains a day. Each train consists usually of a four-axled motor-car and one trailer. Each motor-car is equipped with four eighty-five-horse-power motors, two of which drive the running wheels in the usual way, while the other two drive the rack gears through double reduction gears. On the adhesion section of the line, the first two motors only are used, while on the rack section all four motors are in service, so that the full equipment of 340 horse-power is available. All four motors are controlled by a single controller, which is interlocked to prevent any wrong combination connections. The motors are operated on the series parallel system. Each motor-car is equipped with four independent brakes, one a mechanical hand brake acting through eight brake-shoes, another a hand brake on the shaft of the motors driving the rack gears, the third is a rheostatic brake, and the fourth an automatic brake which grips the sides of the rack, if the speed down grade exceeds six miles an hour. All the brakes can be worked at any time from either end of the car.—*Abstracted from Electrical Engineering (London), July 25.*

Electrical Driving in South Wales.

A brief description is given here of the electrical equipment of a tin-plate rolling mill in South Wales which has been in successful service for some time. The rolls here are of the non-reversing type, and operate continuously for fairly long periods. This simplifies the conditions considerably, but it is still necessary to make the heavy load fluctuations due to the entering and rolling of the plates, and also to provide close speed regulation. It is also necessary to arrange the equipment so that the rolls can be turned over slowly for turning up. These rolls are arranged in four trains, each of which consists of three pair of rolls. A fifty-horse-power slow speed, slip-ring induction motor is geared to each roll-shaft. The speed of the motor is approximately 240 revolutions a minute. They are started by means of liquid rheostats, which enable fine gradations and speed to be obtained. However, to avoid heavy starting currents, which would result in starting the rolls of the main motors, a ten-horse-power variable-speed induction motor drives a worm-shaft running the length of the mill, which is geared to worm-wheels on the roll-shafts. The worm for each train of rolls is fitted with a clutch, so that it can be thrown in gear, when required. This motor starts the rolls, and brings them up to a speed of two revolutions a minute. The worm is then thrown out of gear, and the main motor takes up the load, bringing the rolls up to the required speed. Although no complete tests have been made on this plant, measurements indicate that the size of the motors is about right. Power for the twelve sets of rolls is 150-horse-power, or twelve-and-one-half-horse-power for each pair of rolls. It is said that the result of this method of driving has increased the output of the mill from a little over 3,000 to fully 4,000 boxes of plate a week, the gain being due entirely to the steadiness of the drive, which has the additional advantage of turning out cleaner and better work. The rolls are eighteen inches in diameter, and vary from twenty-four to forty-six inches in length. Power is supplied to the mill from a 200-kilowatt alternator operating at 550 volts, fifty cycles, three-phase.—*Abstracted from the Electrical Review (London), July 26.*

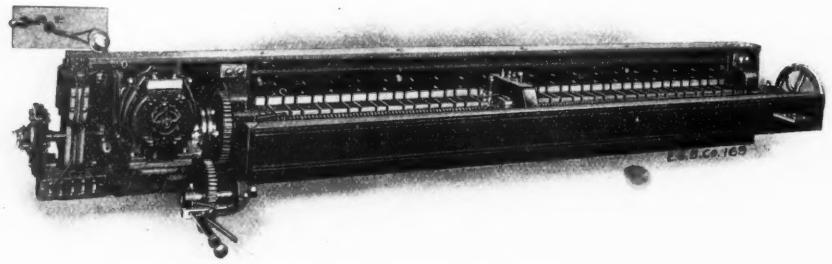
Reno, Nev., is undertaking a project to raise $2,400 to place ornamental lamp posts and cluster lights on the main street. The city electrician is in charge of the project.

INDUSTRIAL SECTION

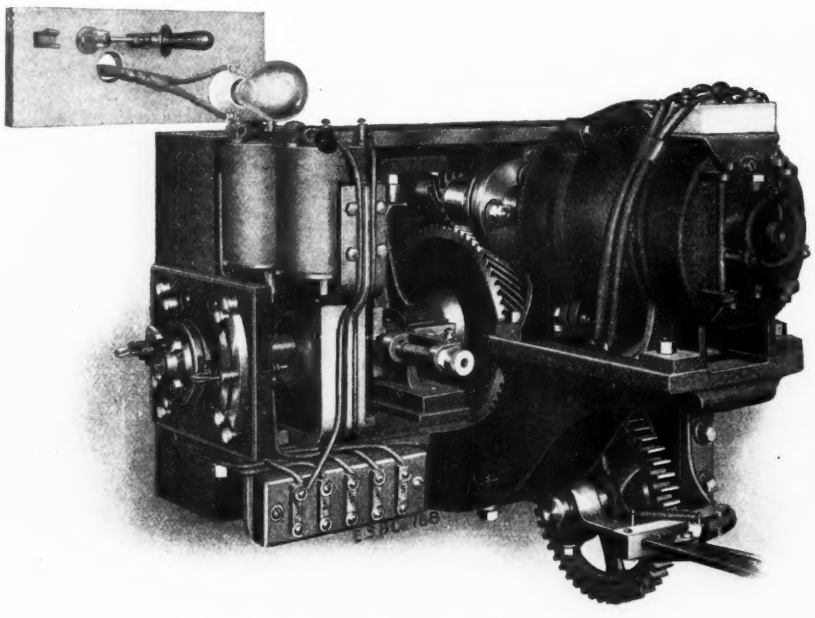
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

High-Speed Magnetic-Control End-Cell Switch.

The increasing use of storage batteries for carrying heavy loads in emergency conditions and for insuring exciting current at all times has necessitated the development of improved forms of end-cell switch. One of these improved switches, brought out by the Electric Storage Battery Company, Philadelphia, Pa., is designed to increase the rapidity of travel of the end-cell switch, thus preventing a drop in voltage when a heavy sustained discharge is thrown upon the battery. This switch is shown in the accompanying illustrations. It runs at a much higher speed than the older type of end-cell switch, and has a magnetic control, which is said to be superior to the old push-button control. The speed of operation is such that a switch with twenty points will travel over the entire number of contacts in fifteen seconds, when the control motor is operated on a 110-volt circuit. This motor will operate through a range in pressure from 125 to seventy-five volts. At the lower voltage the speed of travel over the point of contact is twenty seconds. The motor is a shunt machine, and drives through spiral gears instead of the worm and wheel used in the older types. This change in arrangement makes it possible to operate two motors in parallel.



End-Cell Switch and Motor.



Details of Motor Driving End-Cell Switch.

The following advantages are claimed by the maker for this switch: the end-cell switch can be controlled from any number of points. Only five wires are required between this entire switch and the end-cell switch, including one for the signal lamp, which indicates when the traveling brush is in the proper position on the contact. This is two wires less than with the earlier design. The magnetic control is positive, and after the control switch has been opened, no other manipulation of the control switches will prevent the traveling brush of the end-cell switch from reaching a stop on the next contact, which is an insurance against mistakes in operation. These new control switches are more compact and said to be simpler and to occupy less space than the push-button switches.

The end-cell switch proper has not been changed in its details from the older type, and the new controlling apparatus can be applied to any of those switches now in service.

The Gould Tandem-Couple Type Cell.

To all who have had occasion to use storage batteries, the question of separating the plates is a most serious one. Different kinds of wood treated with different kinds of acid have been employed; different kinds of rubber perforated, bent, ribbed, single and double, have been employed with and without additional wood separators; glass rods and wood rods have been employed alone and in combination with some of the above methods in order to satisfactorily solve the question of the separation between plates.

When small amounts of current are required, as in operating police, fire alarm, railway signals, telegraph and private telephone exchanges and the like, this problem has been very cleverly solved in the novel design gotten up recently by the Gould Storage Battery Company, New York city, and termed the Gould tandem-couple type cell. The question of what kind of separator to use is now unnecessary, as in the new design no separation is needed whatever.

The essential characteristic of this cell is that the plates are set end to end in each cell, one positive plate and one negative plate only, in each glass jar. This differs from the old method of placing plates side by side in the jar or tank where the charging and discharging took

place from one side of each plate only; which produced a tendency toward buckling and caused the wear and tear to take place on one side only.

With the plates placed end to end, the discharge takes place from both sides of the plate and from practically all parts of the plates at once, as the current rate is very low for this class of work. This construction eliminates the chance of grounding or short-circuit between plates for which there is more or less chance when plates are placed side by side.

A striking advantage of this new design, and one which will appeal to the operating man as a distinct time saver, is that the removal of any couple for inspection, cleaning or renewal is not attended by unbolting of connections, sawing of lead, the accompanying lead-burning outfit, etc. The positive plate of one cell is lead burned to the negative of the next cell, no bolted connections being used whatever except at the end of the rows. This insures perfect contact between all the cells and eliminates all chances of the circuits being interrupted on account of poor connections—a point of considerable importance, especially in fire-alarm work.

This method of grouping at the same time greatly facilitates the replacing of any couple with the minimum possible interruption to the circuit, the changing of all groups in the set being a matter of only a few minutes, as there are practically no connections to unbolt and positively no separators to remove and replace, and it is a money saver on first cost as well as on maintenance, because it does away with the use of separators for this class of work, thus cheapening and simplifying the construction of the battery.

Allis-Chalmers Induction Motors Belted to Paint-Grinding Machinery versus Motors Direct-Connected.

The paint grinding machinery of a certain large Western manufacturer of pigments, the Wadsworth-Howland Company, of Chicago, has for some months past been operated by means of forty-odd Allis-Chalmers three-phase, sixty-cycle, 220-volt, belted induction motors, ranging from one-horse-power to thirty-horse-power, all of which are suspended from the ceiling.

The motors are at present operated by power purchased from the local lighting company, although a 100-kilowatt engine-driven alternator is available for use if necessary. In order to ascertain the exact difference in power consumption between belted and geared motors, and the relative efficiencies of the two methods, a test was made on one of the paint grinders, and the power actually consumed was accurately measured, using first a belted Allis-Chalmers motor, and second a geared motor of another design.

The mill on which the tests were made is used for grinding yellow ochre, after it has passed through a mixer. The machine consists of two pairs of millstones about 30 inches diameter, each mounted with axis vertical. The lower stones of each pair revolve while the upper stones are fixed. One pair of stones is located in front of, and below the other, so that the paint discharged from the upper pair will drop into the hopper of the lower. The fixed stones are fastened to the frame of the mill while the lower revolving stones are carried on the ends of vertical shafts connected together by spur gearing and driven from the main shaft by a bevel gear and pinion. The main shaft runs at a speed of approximately 132-136 revolutions per minute, and with the present belted outfit is provided with tight and loose belt pulleys. The mill is driven from a small countershaft located directly above the main shaft, the motor being suspended from the ceiling and located about ten feet from the countershaft.

Paint mixed with linseed oil is fed, from a mixer, into the upper pair of stones, and after passing through them is discharged into the lower pair. The process is continuous, and when the mill is first started, it requires considerably more power than after an hour or so, when the stones have become heated and the paint more easy flowing. The power required also depends on the rate of feed, and the setting of the stones; if the stones are too tightly adjusted, the power required is very much increased. In these tests every precaution was taken to have adjustment of the stones, and the rate of feed the same in each case; the wheels for adjusting the stones were marked so that they could be brought to exactly the same position in each test.

Each of these grinders is provided with an individual ten-horse-power belted motor running at approximately 1,130 revolutions per minute at full load, and equipped with a type "A" potential starter. The following tests were made: first, motor running idle with belt off. Second: motor running belting and countershaft, mill belt on loose pulley. Third: motor running mill and grinding paint.

In tests one and two, readings of volts, amperes and watts were taken, Weston instruments being used for measuring volts and watts. Current was measured by a Thompson ammeter, which had a range of only 15 amperes, and hence was not available for load readings. In test three, indicating wattmeter readings were taken at the beginning, and end of the test, and in addition a Fort Wayne polyphase recording watt-hour meter, installed by the lighting company, was placed in circuit to record the total watt-hours during the run. A four-hour run was made, the mill being cold when started. Allis-Chalmers motor, ten-horse-power, 220-volt, twenty-six amperes, three-phase, sixty-cycle, 1,130 revolutions per minute:

	Belted.	Geared.
Watts (motor running idle)	600	400
Watts (motor running belt and countershaft)	900	...
Watts motor running mill (beginning to run)	10,300	12,300
Watts motor running mill (end of run)	7,200	8,500
Kilowatt-hours for four hours' run (from recording wattmeter)	26	28.5
Total weight of paint ground, pounds	86.75	73.5
Average power-factor	90	80

From the wattmeter readings given, and also from the recorded power consumption for the four-hour run, it is plain that the geared slow-speed motor, instead of saving power, actually required about ten per cent more power than the belt drive. On a longer run, the showing of the geared motor might be improved somewhat because the overload period, during which this motor has a low efficiency, would then be a smaller part of the total. It will be noted that the amount of paint ground with the geared motor was less than with the belted, showing that the greater power consumption was not due to any increase in the amount of paint fed into the mill.

The geared motor must necessarily be run at slower speed than the belted, and a slow-speed, sixty-cycle motor of small output is inferior in electrical performance to a higher speed belted machine. Its no-load losses may be less than for the belted motor as in the present test, but its efficiency at or near full load will be lower.

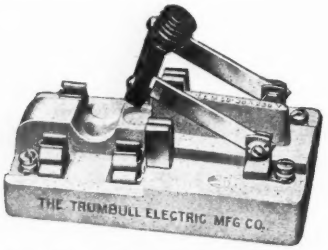
The lower power-factor of the slow speed motor is not a great objection where power is supplied from a large system since power is measured by watt-hour meters. If, however, the motors were at any time operated from the customer's isolated plant the lower power-factor

would be a decided disadvantage, as the current output of the generator is limited.

The amount of paint ground in each case was considerably lower than would have been obtained under average conditions, because the millstones were not in first-class condition. This, however, does not affect the value of the tests as concerns relative power consumption because the condition of the mill was the same in each case. Also the recording wattmeter readings were low compared with those of the indicating instrument which was carefully checked before the test and found to be accurate within one per cent. The same instruments were, however, used in each test, the primary object of which was to obtain comparative data.

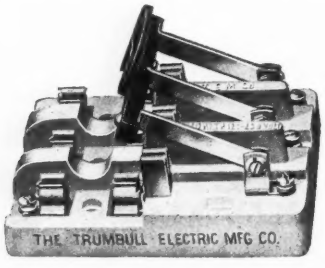
New Trumbull Combination Switches.

The Trumbull Electric Manufacturing Company, Plainville, Ct., announces the following combination switches for National Electric Code fuses, mounted on porcelain bases, thirty amperes, 250 volts,



NEW TWO-POLE, SINGLE-THROW COMBINATION SWITCH.

approved July 5, 1907, electric report No. 1202: Catalogue No. 704, double-pole, three and one-half inches by six inches, for wires entering from the top; catalogue No. 705, three-pole, four and one-half inches by six inches, for wires entering from the top; catalogue No. 724, double-



NEW THREE-POLE, SINGLE-THROW COMBINATION SWITCH.

pole, three and one-half inches, for wires entering from the bottom; catalogue No. 725, three-pole, four and one-half inches by six inches, for wires entering from the bottom.

SPEED REGULATION OF INTERNAL-COMBUSTION ENGINES AND ITS RELATION TO THERMAL EFFICIENCY UNDER VARYING LOADS.

BY G. P. HUTCHINS.

In the matter of governing, all the great classes of prime movers excepting the steam engines are still seeking for satisfactory and dependable devices. With all the great progress and experiments made with water-wheel governors, the problem is by no means solved. Some of the unquestionable merits of internal combustion engines for certain services, are in a large manner offset by the difficulty, not to say impossibility, thus far found in securing proper regulation.

Governing of gas and gasolene engines is effected in a variety of ways, which may be grouped under two headings: the "hit and miss" method and the variable impulse system. From the first building of internal combustion motors, it was seen that intermission of occasional power-strokes or increasing their number, would produce a control of the engine speed. To this day this principle is most prevalent in American and English practice. The name is unfortunately misleading, as it is identified with the idea of guesswork, or trial and error, indicating lack of precision or control of the "misses" or "fires," which is by no means the case. A more accurate name is here suggested in "constant impulse of variable period," which could be contrasted with "variable impulse of regular period," giving a very clear line of differentiation.

An ordinary centrifugal governor controls the amount of gas inlet opening, while air admission remains independent and occurs at each cycle. Thus the number of admissions of fuel varies with the work of the engine, while the value or composition of the charge admitted as well as the compression remain constant. In one application of this principle, a metal stop or slide connected by levers with the governor spindle, is interposed between the fuel admission valve and its actuating lever or cam. As long as it remains there, the periodic cam-lift admits gas to the mixing chamber. When excessive speed causes governor retraction of the slide, the fuel valve receives no lifting impact and remains closed until the slide has been returned by governor action in obedience to reduced speed.

For regulation under variable load, and particularly under light load, this method gives the most economical results of all the usually employed systems of governing, but the mechanical defects introduced by it detract from the theoretical advantages of such regulation. The principal drawback is the necessity for unusually heavy flywheels, which, according to R. Mathot, the well-known French scientist, produce a steady decrease of output of from three to five per cent. After several successive "misses" there is danger of a powerful explosive action on the very slowly-moving parts, which, owing to the inertia of the heavy flywheel, may produce a breakage.

The system we here called "variable impulse of regular period" divides itself into the method of constant quality with variable quantity of mixture, and that of constant quantity but variable quality. In the first method, the regulator is very similar to the ordinary centrifugal steam governor. It is attached between the carbureter and the cylinder, acting on a butterfly regulating valve to throttle the mixture of air and gas as a whole. By varying the discharge from the carbureter and the draft upon it, undue variations in the mixture proportions are produced, so that the act of throttling to govern often occasions additional speed disturbances, similar to the "hunting" of a water-turbine governor. This system requires usually a very heavy governor, and is uneconomical, because it necessitates increased compression in order to produce explosion, because the total quantity of air where admitted is frequently so small that compression falls below the ignition point. For every gas mixture and volume, there is one and but one degree of compression, which produces the most nearly complete combustion and greatest engine efficiency. All compression beyond this point is a direct loss, as it robs useful work from the engine with the added danger of premature ignition of the gas by the heat of compression.

For the same reason the method of constant quantity and variable quality is defective. Variation in the amplitude and duration of the gas inlet opening is secured by some connections, usually a conical cam, with the governor-controlled levers. This leaves the air supply constant but varies the gas mixture, according to engine speed.

Whatever detail of device be used, it must be actuated by the mainshaft and operate on the carbureter mechanism. This method is even less satisfactory than the foregoing. The effect of changed fuel supply makes itself felt later, and the change can not be controlled with sufficient exactness. When there is too much hydrocarbon in proportion to the air, com-

bustion will be incomplete, causing unburned or incompletely consumed fuel to be exhausted, that is, thrown away, and logging the cylinder walls, piston head, valves and ports with partially burnt carbon as soot and greasy grime. Such impurities, if not quickly scavenged out, are apt to produce pre-ignition and back-firing by becoming incandescent. If the explosive mixture is too much diluted, it will not explode at all. Evidently, in both cases there is danger of going too far in the direction necessary to correct speed irregularity just as complete closing of a steam engine throttle in order to reduce speed is defective in that it shuts down the whole plant.

To secure explosion on light loads in this system, compression is increased to the detriment of economy, and when under slower speed the mixture becomes richer, pre-ignition is apt to occur because the compression has remained too high. The engine may be stopped or injured by breaking of connecting rod or crank.

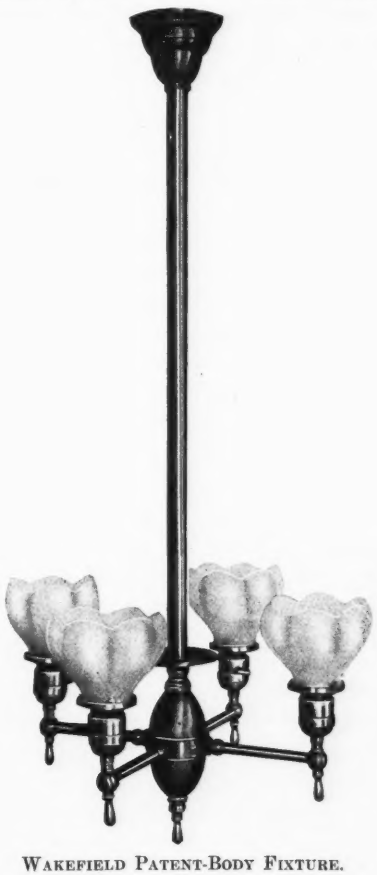
In special cases where fuel economy is a secondary consideration, as with automobile engines, speed is controlled by varying the point of ignition with respect to the stroke. As the full mixture charge is admitted each time and exhausted, whether ignited or not, it would be difficult to imagine a more wasteful method of governing.

In striking contrast with such unreliable and uneconomical regulation is the method of governing in use on the Diesel crude oil engine. A small flywheel governor driven by the mainshaft controls a valve in a by-pass pipe connected to the fuel pump, which is so arranged as to raise its maximum quantity of the fuel oil at each stroke. The quantity injected into the cylinder depends on whether the governor permits the oil to flow to the injector valve by closing the by-pass, or whether all or a part of it is returned to the supply tank through the more or less opened by-pass. There can never be an excess of fuel injected into the cylinder, because the Diesel principle provides for a normal large excess of air in the cylinder. There can not be a failure to explode from insufficient hydrocarbon admixture, because there are no explosions. Whatever oil is sprayed into the cylinder is consumed as fast as it enters, the air in the cylinder being raised by compression to a temperature far beyond the ignition point of mineral oils. Thus, waste by incomplete combustion is simply precluded, no matter what the degree of governing. Be the quantity great or small, there can be no variation of thermal efficiency, because every particle of fuel is consumed, as is evidenced by absolutely clean cylinder walls after months of running.

In mechanical detail and in thermodynamic effect, the Diesel governor works just as positively and as irrespective of conditions within the cylinder as does the steam engine governor, hence its regulation is just about as close, as economical and as reliable. The fact that this engine produces in practice almost precisely that degree of efficiency which Herr Diesel had from theoretical considerations judged to be the highest attainable, and which he had set before himself as a goal even before the first model was made, indicates that here the problem of governing internal combustion engines has been solved up to the limits imposed by nature.

Standard Universal Lighting Fixtures.

One of the most useful adaptations of the idea of a universal electrolier is found in the patent-body fixture placed on the market by the F. W. Wakefield Brass Company, Vermilion, Ohio. These standard universal lighting fixtures, an illustration of which is shown herewith, are interchangeable, a two, three or four-light fixture being available with one stem. Where six different styles of fixtures in two and three-light are now carried, this patent body makes available thirty-six different patterns for the same amount of money in two, three, and four-light.



WAKEFIELD PATENT-BODY FIXTURE.

Committees Appointed by the Empire State Gas and Electric Association.

At the June meeting of the Empire State Gas and Electric Association, held at Lake Champlain, N. Y., resolutions were passed authorizing the executive committee to appoint three committees, one on the Public Utilities Commission, one on accounting and one on insurance. The following appointments have been announced:

Public Utilities Commission: W. W. Freeman, vice-president and general manager Edison Electric Illuminating Company of Brooklyn; M. J. Brayton, secretary Utica Gas and Electric Company; Charles R. Huntley, president and manager Buffalo General Electric Company.

Accounting committee: R. A. Carter, treasurer Westchester Lighting Company; A. S. Cooke, auditor United Gas and Electric Company; G. W. Curran, assistant general agent United Gas Improvement Company.

Insurance committee: R. A. Davidson, president Hudson Counties Gas and Electric Company; T. O. Horton, secretary New York & Richmond Gas Company; L. W. Emerick, vice-president Fulton Light, Heat and Power Company.

Meeting of the Ohio Independent Telephone Association.

The Ohio Independent Telephone Association held a special session at the Southern Hotel, Columbus, Ohio, on August 6. There were about 350 representatives in attendance, the meeting being presided over by Frank L. Beam, of Mount Vernon.

H. M. Dougherty, a director of the Columbus Citizens' Telephone Company, spoke on "Why Is Independent Telephony So Successful?" W. G. Thompson, of Hamilton, James B. Hoge, of Cleveland, and H. B. Folsom, of Circleville, discussed "Why Is Competition Desirable in the Telephone Business?" A. Hess, of Sidney, discussed the general laws of Ohio with reference to the telephone business.

Resolutions were passed authorizing the executive committee to take such steps as might be necessary to prevent member companies from entering into arrangements whereby competition is eliminated.

THE ANNUAL CONVENTION OF THE OHIO ELECTRIC LIGHT ASSOCIATION.

TOLEDO, OHIO, AUGUST 20-22.

The thirteenth annual convention of the Ohio Electric Light Association will be held at Toledo, Ohio, August 20-22. The sessions will be held in the New Boody House, and a preliminary session for organization will be held at 5 P. M. on August 19. On the evening of August 19 there will be a theatre party at the Casino.

The first formal session of the convention will be called to order at 10 A. M. on Tuesday, August 20. The presidential address will be delivered by W. P. Engel, Defiance. The following papers will be presented: "Factory Lighting," A. P. Biggs, Detroit, Mich., and J. Kermode, Cleveland. The report of the Committee on Uniform Accounting will be presented in the form of papers by F. E. Crawford, Cleveland, and D. W. Low, Alliance.

The afternoon session will be called to order at 2 P. M., and a paper entitled "Luminous Arcs from the Standpoint of Central Station Operation" will be presented by H. P. Grabhill. The report of the Committee on Electric Heating Devices will be presented by M. E. Turner, Cleveland. Following the reading of papers there will be an executive session.

On Tuesday afternoon there will be a prize contest by the ladies at Toledo Beach. Supper will be served at the beach, after which there will be dancing.

On Wednesday, August 21, the first session will be called to order at 9.30 A. M. J. Robert Crouse, of the Cooperative Electrical Development Association, will present a paper entitled "Cooperative Commercialism in the Electrical Field." Following this, Professor F. C. Caldwell, of the Ohio State University, will present a paper entitled "The Best Form of Power for Stations of 500 Kilowatts Capacity or Less."

The second session will be called to order at 2 P. M. The report of the Committee on High-Efficiency Lighting Units will be presented in the form of papers by C. C. Collins and A. N. Cope, Columbus. Three papers on the subject of "Helps to a Solicitor" will be presented by Frank Maunsell, Toledo; J. D. Kenyon, Chicago, and A. S. Miller, Dayton, respectively. The report of the Committee on Cost Determinations will be presented by M. E. Turner, Cleveland, and F. M. Tait, Dayton.

On Wednesday morning there will be a card party for the ladies, and in the afternoon a second contest for prizes. For Wednesday evening the association has chartered the steamer Greyhound for a trip on Lake Erie.

On Thursday, August 22, the first session will be called to order at 9.30 A. M. Papers on the subject, "Best Ways to Meet Gas and Gasolene Competition," will be presented by F. H. Golding, Dayton; Samuel Rust, Greenville; W. E. Russell, Massillon; Arthur Pomeroy, Cleveland; E. T. Selig, Mount Vernon, and W. C. Anderson, Canton.

Following the reading and discussion of papers, the reports of the secretary and treasurer will be read, new officers will be elected, the question box will be discussed, and an executive session will be held.

In the morning and afternoon there will be contests for prizes by the ladies.

Marconi Ready to Take Transatlantic Business by October 1.

Newspaper despatches from London, England, dated August 13, state that William Marconi will leave England on August 22 to inaugurate a transatlantic wireless telegraph service. The officials of the company anticipate that all preparations will be completed before the middle of September, and say that satisfactory exchanges of messages between the Irish station at Clifton and the Canadian station at Cape Breton have been going on for weeks past.

The schedule of charges is issued, showing the rates to be ten cents a word plus the land charges for ordinary messages, and five cents a word plus the land charges for press messages.

In connection with this the controversy between Marconi and the Dominion government is interesting. Marconi asserts that when the government gives notice of its intention to establish a wireless telegraph station the company, under the terms of its agreement, has the option of erecting and operating the station. This the government denies, so Marconi has started legal action to settle this point in the agreement.

The Hon. A. B. Aylesworth, Minister of Justice, has advised the Department of Marine that there is nothing in the terms of the agreement preventing the crown from erecting a wireless station and equipping it with instruments other than the Marconi instruments.

Acting on this advice the Dominion government is establishing and operating wireless stations on the Pacific Coast independent of the Marconi company.

Chicago Traction Order Signed.

On August 12, Judge Grosscup, in the United States Circuit Court, Chicago, Ill., issued the final order turning over to the Chicago Railways Company all the street railways on the north and west sides of the city, which heretofore have been operated under the name of the Chicago Union Traction Company. Under the stipulations of the ordinance the Chicago Railways Company will expend $12,000,000 within the next three years in the rehabilitation of these lines.

This week will conclude the history of the Union Traction Company, the North and West Chicago Street Railroad companies, and the North City, West Division and Passenger Railway companies as active corporations transacting business in Chicago.

Immediately after the signing of the order, Attorney Frank H. McCulloch, of McCulloch & McCulloch, representing the Chicago Title and Trust Company, applied for an appeal from the order on behalf of his client, who holds first mortgages amounting to $4,012,000 on the West and $500,000 on the North Side lines. The application will be heard Monday.

Buckeye Electric Company Conference.

The annual conference of the officers and salesmen of the Buckeye Electric Company was held in Cleveland, Ohio, August 8, 9 and 10. Headquarters were established at the Euclid Hotel. Topical addresses were made and important subjects discussed. Visits of inspection were made to the Buckeye factory, and theatre parties and the annual banquet afforded pleasant recreation. The conference was participated in by a number of the Buckeye company's jobbers.

Telegraph Operators Strike.

During the week considerable disaffection has been evidenced by the telegraph operators employed by both the Western Union and Postal companies, culminating in a walk-out by a large part of the men and women working in Chicago, New York and in some of the cities in New England. Labor Commissioner Neill has endeavored to effect a suspension of strike orders, pending an arbitration of grievances, but it is possible that the strike will become general.

Current Electrical News

DOMESTIC AND EXPORT.

NEW YORK AND QUEENS ELECTRIC SEEKS TO ISSUE $2,000,000—Commissioner McCarroll of the Public Service Commission gave a hearing August 8 on the application of the New York & Queens County Electric Light and Power Company for permission to issue $2,000,000 in bonds for extension, equipment and refunding. No one appeared in opposition. Attorneys for the company were present to urge the commission to grant the application. The company expects to issue bonds to the extent of $1,000,000 first if the application be approved.

MERGER OF INDIANA TRACTIONS—Governor Stuart has approved the articles for the merger of several Indiana county trolley lines, in which a number of prominent men are interested, under the name of the Indiana County Railways Company, of Indiana, with a capital stock of $457,000. The companies consolidated with the above-named are the Indiana, Clymer & Creekside and the Indiana, Punxsutawney & Sagamore, recently chartered. The president is D. H. Clark, of Punxsutawney, the other officers being: T. L. Eyre, West Chester, vice-president; J. A. Klingensmith, Indiana, secretary and treasurer, and the following directors: W. F. Elkin, Indiana; B. M. Clark, Punxsutawney; G. W. Kipp, Towanda; H. E. Clark, Glen Campbell.

MILWAUKEE STREET LIGHTING CONTRACT SIGNED—The contract between the city and the Milwaukee Electric Railway and Light Company for street lighting was signed on August 3. It provides for lighting the streets from December, 1905, for a period of five years at $65 per lamp. The company is to receive no interest on the bills due the company from that date and the city is authorized to continue the contract indefinitely after its expiration, terminating it upon giving sixty days' notice to the company. The rates can be changed from time to time upon order of the railroad commission of Wisconsin after complaint of either party and hearings according to law. The contract was signed by John I. Beggs, president and general manager, and F. J. Boehm, assistant secretary for the company; with Charles F. Pfister and Fred Vogel, Jr., as sureties, and for the city by the commissioners of public works and the comptroller and approved as to form and execution by the city attorney. This is the end of the agitation which followed the expiration of the old contract which called for $81 for lights fed by overhead wires and $98 for lights fed by underground wires. During the agitation, Mr. Beggs threatened to turn off the lights and leave the city in darkness unless the aldermen entered into a new contract, but this was not done. The contract offered by the company was at the figures finally adopted by the city although the provision for appealing to the rate commission in the event of dissatisfaction was not suggested at that time.

NEW YORK CITY MUNICIPAL PLANT A FINANCIAL FAILURE—The plant installed by the city of New York to illuminate the Williamsburg bridge has been discontinued as a source of electrical energy and the city has advertised for bids for lighting the structure. Too much expense is the reason given for the abandonment of the plan. Chief Engineer Lacombe, of the Department of Water, Gas and Electricity, says the street refuse burned too slowly and did not give light cheaply enough. It is declared that the cost approximately of lighting the bridge by the incinerator was $50,000 a year, whereas the Edison company, which is now doing the work, could do the work for about $25,000. When the incinerator was established, former commissioner Woodbury estimated that the cost of running it would be $45.22 a day, including labor, ash removals, supplies and interest. It was thought that the incinerator would save the city about $30,360 a year. The plant supplied 180 arc lamps. There were also 767 sixteen-candle-power incandescent lights, three electric motors and twenty electric heaters run by it. The waste was first sorted, trimmers paying $1.50 a ton for rubber, rags and various grades of paper and other material. Official data show that the trimmers utilized sixty per cent of the waste, the remainder being incinerated and developed into power. The plant had two 200-horse-power boilers and two 200-kilowatt and one 10-kilowatt direct-connected units. H. D. Parsons, then the consulting engineer for the Street Cleaning and Bridge departments, designed it. Street Cleaning Commissioner Bensel said that while the plant had been abandoned as a light generator, it would still be used as an incinerator.

PERSONAL MENTION.

MR. C. W. HUMPHREY announces the opening of an office for consulting and designing engineering, at the Rookery, Chicago, Ill.

MR. WILLIAM R. WESTCOTT, the retiring manager of the Manchester, N. H., telephone exchange, was presented on the eve of his departure with a traveling bag and a silver-mounted toilet set by the employés who had been under his direction.

MR. LEE H. RAY has been made superintendent of the Sterling, Dixon & Eastern Electric Railroad, with headquarters at Sterling, Ill., succeeding F. Gillett. Mr. Ray has recently been connected with the Winnebago Traction Company, of Oshkosh, Wis.

MR. J. C. NORCROSS, for the past three years manager of the light and power department for the town of Hudson, Mass., has resigned to accept a like position with the town of Reading, Mass. Mr. Norcross is secretary-treasurer of the Municipal Lighting Association of Massachusetts.

MR. HEBER J. GRANT has been elected president of the Utah Independent Telephone Company, *vice* Heber M. Wells, resigned. This is the first step in the reorganization of the Utah company. Mr. Grant is president of Heber J. Grant & Company, and the Home Fire Insurance Company, of Utah.

MR. AVERY P. ECKERT has accepted the general sales management of the Duplex Metals Company, Chester, Pa., with New York offices at 208 Fifth avenue. He will make his headquarters at the New York office. Mr. Eckert has been sales manager of the Safety Insulated Wire and Cable Company, of New York, for many years. He is one of the pioneers in the manufacture and sale of insulated wires and cables.

MR. Z. A. CAHOON, manager of the New England Telephone Exchange at Chelsea, Mass., has been transferred to the position of manager of the larger exchange at Malden. Mr. Cahoon is to be succeeded by Mr. G. P. Norwell, of Winchester. Mr. Norwell has been with the company for four years, having started in with the students' course and working his way upward. He has been the manager for the Stoneham and Winchester exchanges.

MR. EDGAR C. BRADLEY has been elected vice-president and general manager of the Pacific Telephone and Telegraph Company, succeeding Emil J. Zimmer. Mr. Bradley will have charge of all matters pertaining to the affairs and business of the company and his office will be in San Francisco. Mr. Bradley resigned in August, 1906, as second vice-president of the Postal Telegraph-Cable Company, to accept a leading position on the staff of President Fish of the American Telephone and Telegraph Company. He superintended the reconstruction of the Pacific company's lines, rehabilitating that portion of the system destroyed by the earthquake and fire.

MR. JOHN C. OSTRUP has been appointed to fill the chair of structural engineering at the Stevens Institute of Technology, Hoboken, N. J. Professor Ostrup is a graduate of the Polytechnic School in Copenhagen, and later took a post-graduate course at the Chicago Engineering School, and has had a large and varied experience in important work extending over seventeen years. He was for five years in charge of the office work and design of the Lake Street, the Northwestern and the Union Elevated Railroads in Chicago during their construction, and afterwards designing engineer of the Boston Elevated Railroad during its building. Upon the completion of this he went into private practice for four years, and has, for the past two years, designed many important structures and bridges for the American Bridge Company, of New York.

ELECTRIC RAILWAYS.

NEWARK, N. J.—The road committee of the Essex county board of freeholders in Newark granted a franchise to the Morris County Traction Company to lay tracks on Springfield avenue from Main street, Milburn, to Maplewood. The road will connect Summit and Newark by trolley.

LEXINGTON, KY.—In the county clerk's office articles have been filed by which the Versailles-Frankfort Interurban road passes into the entire possession of the Central Kentucky Traction Company, the operating company of the Georgetown & Paris electric lines. The holdings are controlled by Philadelphia capitalists.

NEW BRUNSWICK, N. J.—The Jersey Central Traction Company has applied to the board of freeholders for a franchise to lay its tracks for a distance of 700 feet on Bordentown avenue, South Amboy. This stretch of land was left out of the description when the company secured its right to cross the Amboy bridge from the county.

ALLIANCE, OHIO—Application was filed on July 31 at Columbus for a charter incorporating the Youngstown, Alliance & Akron Electric Railway Company. The incorporators are T. H. Given, president Farmers' National Bank, Pittsburg; M. K. McMullen, Pittsburg; Hugh Bleakley, Enos Brosius and Henry Shaffer, Alliance. It is announced that President Callery of the Pittsburg Railways Company will be vice-president of the concern, which has a nominal capital of $10,000.

BOSTON, MASS.—The railroad commissioners have issued an order authorizing the Springfield & Eastern Street Railroad Company to issue $530,000 additional capital stock. This is one of the companies incorporated in connection with the new high-speed direct line between Worcester and Springfield. The money derived from the sale of the stock is to be devoted to paying off the floating debt incurred in reconstructing and extending the road to bring it up to requirements for the new rapid transit inter-city traffic.

DETROIT, MICH.—A new company known as the Detroit & Adrian Traction Company, with a capital of $2,000,000, is reported as being formed in Detroit, with the Security Trust Company as trustee. It is estimated that it will cost $1,459,430 to build and equip the road, which will be sixty-one and one-half miles in length. The line will touch the villages of Tecumseh and Milan, besides many smaller settlements. Arrangements are also said to be about completed to construct a trolley line from Lansing to Jackson.

NASHVILLE, TENN.—R. E. Chambers, formerly of Boston, but now of Cincinnati, is promoting a trolley line from Nashville to Louisville, connecting at that place with the network of trolley lines traversing Ohio, Indiana, Kentucky, Missouri, Pennsylvania and other states. He has been with Nashville capitalists looking over the local situation. He represents a circle of capitalists in Cincinnati, Louisville and other cities, and declares that the matter of a trolley line from here to Louisville is being seriously considered.

ELKHART, IND.—Terms for a franchise granting the Deiterich-Murdock Electric Railway syndicate use of the streets of Elkhart for thirty years have been agreed upon by the company's officials and the board of public works. The syndicate owns the Chicago, South Bend & Northern Indiana Interurban, including the Elkhart city lines. The Deiterich-Murdock syndicate also owns and operates a gigantic system of interurban railways in northern Indiana, and has plans under way for connecting cities in this section of the state with Indianapolis.

ATLANTA, GA.—An important addition to Georgia's meagre system of interurban trolley lines will be the proposed Augusta-Atlanta railway which is to be constructed from Atlanta to Augusta, a distance of 160 miles. Atlanta capitalists are behind the company, which has an authorized capital of $5,000,000. Surveys are now being made for the line by the Carolina Construction Company, which is an affiliated corporation. James W. English, Sr., president of the Fourth National Bank of Atlanta, is president of the construction company. The financial plans of the railroad have not yet been made public.

GREENVILLE, S. C.—Application will soon be made to the secretary of state for a charter for a standard gauge electric railroad from Greenville to Spartanburg. The company will be incorporated under the name of the Greenville & Spartanburg Railway Company, which proposes to build a line traversing the townships of Greenville, Butler and Chick Springs, in Greenville county, and Beech Springs and Spartanburg in Spartanburg county, making a total distance of thirty-one miles. The road will pass the Chick Springs hotel resort.

MEMPHIS, TENN.—Plans for the building of an interurban line of railway connecting Pine Bluff and Little Rock, Ark., are beginning to assume more definite shape. The company has filed articles of incorporation with the secretary of state, placing the capital stock at $1,000,000. J. J. Fisk, of Chicago, is president; W. H. Langford, Pine Bluff, vice-president, and John M. Rose, Little Rock, secretary-treasurer. Work of securing right of way and making preliminary surveys will begin soon. The management of the road announces that, in addition to building the line from Little Rock to Pine Bluff, there is to be an extension from Pine Bluff to Stuttgart, Ark. Estimated cost is $1,500,000.

WALTHAM, MASS.—Plans have been formulated and a company organized for the purpose of putting Waltham in direct communication by electric railway lines with Marlboro, Weston, Wayland, Sudbury and Maynard. The company is formed under Chapter 516 of the acts of 1906, and has assumed the corporate name of the "Boston, Waltham & Western Electric Railroad Company." The lines which the company proposes to lay down at first consist of a main line with a branch running from South Sudbury to Maynard. The main line will connect Waltham with Weston, Wayland and Marlboro, and will be sixteen and one-half miles in length. The branch is intended to have about six miles of trackage.

LINARES, N. L., MEXICO—Jose Bonilla, a wealthy resident of Linares, has concluded the purchase of the street-car system of this city, including the entire line, all cars, stables and equipment. The figure at which the transfer was made could not be learned, but is understood to have been large. Associated with Mr. Bonilla are Andres Berlanga and Franco Pumarejo, also of this city. The new owner has expressed the intention of greatly improving the lines and the service and of extending the system to include two small towns lying contiguous to this city. The new company is backed by practically unlimited capital and it is believed that the transfer of the lines will have a highly beneficial effect on the city and the outlying districts.

SPOKANE, WASH.—The Chelan Electric Company, capital $500,000, has been incorporated to build an electric railway from Wenatchee to the western part of Washington. The officers of the company are: J. T. McChesney, president, and E. C. Mony, secretary. Other trustees are: H. P. Scott, of Wilmington, Del.; J. A. Coleman and F. H. Brownell. The last-named said the route starts at a point near Wenatchee, following the Columbia river to Lake Chelan, thence north to the Okanogan river and from there to the end of the state. Lighting and water privileges for all towns along the Chelan river are included in the articles. There are reports that this is part of the Great Northern Railway Company's plan for the electrification of its system in the Chelan country, west of Spokane.

NEW HAVEN, CT.—The Connecticut Railway Company has placed one of the largest car and equipment orders ever made by a New England trolley concern, costing approximately $5,000 apiece; fourteen snow-plows at $2,500 each, with much other material for operation. This company is buying for the electric trolley service of the New York, New Haven & Hartford Railroad in Connecticut and Rhode Island. Following is the list of cars ordered and their specifications, with the line upon which they will be used: New Haven line, sixteen double-truck, thirty-foot closed cars; Hartford line, twenty-four double-truck, thirty-foot closed cars; Bridgeport line, ten double-truck, thirty-foot closed cars; South Norwalk line, three double-truck, thirty-foot closed cars; New Britain line, two double-truck, thirty-foot closed cars; Milldale line, two double-truck, thirty-foot closed cars; Waterbury line, eleven thirty-foot closed cars; Stafford Springs, four thirty-foot closed cars; New York & Stamford line, twelve thirty-foot closed cars; Norwich line, one thirty-three-foot closed car; Middletown line, eight thirty-three-foot closed cars; Rhode Island lines, thirty-foot closed cars. Connecticut system total, 103 cars.

TELEPHONE AND TELEGRAPH.

WEST FLETCHER, VT.—Poles are being set for a telephone line from Fairfax to West Fletcher, and it is said that telephones will be installed in nearly every house along the line.

RAYVILLE, LA.—Brown M. Dorrity, of Rayville, is making preparations to run a telephone line from Rayville to Mangham and the Gold Mine Plantation, thence to Winnsboro and perhaps further south. It is said that the citizens of Richland and Franklin parishes are subscribing liberally to a subsidy.

WATERTOWN, N. Y.—It is understood here that the Central New York Telephone and Telegraph Company will advance its exchange rates in Watertown. Hereafter no new contracts will be written at the old schedule of rates, because it is claimed that the company is losing money and that it can not afford to do business at a loss. The people who now have service will not be affected at present, but no new business will be written on the old rates. The new schedule calls for $48 for a direct business telephone and $42 for a two-party contract. The new rate for direct residence service will be $30 and $24 for the two-party.

NEW BRUNSWICK, N. J.—The Coast Line Telephone Company is completing the remaining distance between Perth Amboy and New Brunswick, and the probabilities are that telephone connections between New Brunswick and Philadelphia over the lines of this company will be established within the next ten days. The company is now negotiating with the Jersey City authorities for a franchise so that its lines can be extended to that place, but the law passed by the New Jersey legislature at its last session prohibiting the granting of public service franchises with a tenure of more than twenty years has proven a stumbling block in the negotiations.

PEEKSKILL, N. Y.—The State Line Telephone Company now has seven construction gangs at work building lines south of Peekskill and Brewsters to connect up Westchester county with the present system. The company's lines now extend from Columbia county as far south as Peekskill. The proceeds of the bonds issued under the collateral trust mortgage for $5,000,000 made to the Commercial Trust Company of New Jersey in June are now coming in in sufficient amounts to provide for the construction needs at the present time. The money thus raised is costing the company about six and one-third per cent. It is the ultimate intention of this company to confine its operations to Westchester county, a portion of western Connecticut and those counties on the west bank of the Hudson. This will make the company's territory a compact one contiguous to the metropolitan district. The long-distance lines which are now being built to connect the various independent telephone systems in the state will be a big aid to this company, as it will permit of long-distance business being done without relaying through so many switchboards as is at present the case.

ELECTRICAL SECURITIES.

Last week's stock markets realized a rather sensational decline in prices, not only establishing new low levels for the summer, but in some cases for the year. Railroad stocks average about thirty-three points below the year's high level, showing the result of an aggressive bear movement, which, if it did not have the support of large interests, at least was not checked by any activity upon the part of those who might have kept prices up by an opposition movement in the early phases of the decline. In the popular mind the break in the market is associated with the $29,000,000 fine imposed upon the Standard Oil Company by Judge Landis. This has been taken to indicate the direction in which governmental action would proceed with regard to large corporation interests. This case, however, is not settled, as Judge Grosscup last week allowed a writ of error containing 116 claims, which the Standard's attorneys had indicated against the decision. Well-informed bankers lay more stress on the monetary situation than upon this large fine or upon any other indication of governmental action. While call rates are not excessive, it is the rates asked for time loans which are worrying investors, and which are making it difficult for the railroads and other industrials in need of money for expansion to carry out much-needed improvements and enlargements. Whatever effect the recent suits against the corporations may ultimately have upon business in general, the present indications are that the active demand for manufactured articles of every kind has discounted the expected baneful effects. In iron and steel, with the exception of the steel rail department, orders continue to come in in a very encouraging way. Up to July 31 none of the electric companies reflected any slowing down in the volume of orders received. It is expected that the shipments of the Westinghouse company during the current fiscal year will run between $40,000,000 and $45,000,000. In the first six months of its current fiscal year the General Electric Company received new orders aggregating a total of $35,000,000, compared with $29,000,000 in the corresponding period of last year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 10.

New York:	*Closing.*
Allis-Chalmers common	9¼
Allis-Chalmers preferred	26
Brooklyn Rapid Transit	49
Consolidated Gas	111
General Electric	120½
Interborough-Metropolitan common	11
Interborough-Metropolitan preferred	34½
Kings County Electric	119
Mackay Companies (Postal Telegraph and Cables) common	64
Mackay Companies (Postal Telegraph and Cables) preferred	64
Manhattan Elevated	131
Metropolitan Street Railway	—
New York & New Jersey Telephone	107
Western Union	75½
Westinghouse Manufacturing Company	142

An official of the Brooklyn Rapid Transit Company is quoted as follows: "The Brooklyn Rapid Transit system is gradually getting in position to handle the traffic offering, and of late its growth in facilities has kept pace with the growth in traffic. In the 1907-8 fiscal year, one can be pretty safe in figuring on gross earnings of $21,000,000, and this would mean dividends for the stockholders, for the company is now well financed, and it has $3,000,000 cash in the bank. The company has steadily added to its equipment, and recently ordered 100 new surface cars and 100 elevated cars of the semi-convertible type, large size."

The decline in the securities of the Interborough-Metropolitan Company has been accompanied by the rumor that at the next meeting of the company's directors for dividend action the dividend on the preferred stock is to be passed. The dividend is due to be declared again September 5, and, unless the plan of the directors is changed between now and that date, the dividend will be declared and paid as usual. The present investigation by the Public Service Commission, with the probable orders that will result, no doubt will have some effect, at least temporarily, on the company's earnings. Because of the investigation it is possible that later on the directors may change their views regarding the dividend and to decide to pass it temporarily.

Boston:	*Closing.*
American Telephone and Telegraph	105
Edison Electric Illuminating	208
Massachusetts Electric	55
New England Telephone	109
Western Telephone and Telegraph preferred	70

Philadelphia:	*Closing.*
Electric Company of America	8¾
Electric Storage Battery common	49
Electric Storage Battery preferred	49
Philadelphia Electric	7 1/8
Philadelphia Rapid Transit	17⅞
United Gas Improvement	86½

Chicago:	*Closing.*
Chicago Telephone	117
Chicago Edison Light	143½
Metropolitan Elevated preferred	62
National Carbon common	72
National Carbon preferred	112
Union Traction common	—
Union Traction preferred	—

Judge Grosscup decided, on August 9, in the traction receivership litigation, that the Chicago Railways Company should be put in possession of the properties of the North and West Side street-car systems, in accordance with the terms of the new traction ordinance, and announced that he would enter a formal order to that effect as soon as it could be drafted. In rendering the decision to put the Chicago Railways Company in possession, Judge Grosscup announced that "the conscience of the court is satisfied that the order ought to be entered and the judgment of the court is satisfied of its power to enter that order."

ELECTRIC LIGHTING.

HATTIESBURG, MISS.—An electric light and power plant is projected by J. P. Carter, C. H. Lindsley and others who have organized a company and applied for a twenty-five-year franchise.

LITTLE VALLEY, N. Y.—At the special village election held at the town hall August 3 the proposition to bond the village for $10,000 to improve the electric light system was carried by a vote of forty-seven to six.

BURLINGTON, IOWA—The People's Gas and Electric Company has made a new contract with the city and will furnish 241 arcs and sixty-five incandescents at $65 per year for arcs and $16.50 per year for incandescents.

PETERSBURG, VA.—The city council has contracted with the Virginia Passenger and Power Company for lighting the city with electricity for five years at $57 per lamp a year. Arc lamps of 2,000 candle-power are to be furnished. The company is to expend $50,000 in improvements here.

NORTH ADAMS, MASS.—The annual meeting of the directors of the Stamford Light, Heat and Power Company was held on August 5 and the old board of officers was reelected as follows: president, James D. Hunter; vice-president, H. T. Cady; treasurer, Colonel F. S. Richardson; clerk, Charles D. Houghton.

WILKES-BARRE, PA.—The Wilkes-Barre Subway Light and Power Company has had its charter signed by the governor. The charter members are: County Treasurer Dr. Lewis Edwards; attorney Frank Darte; real estate agent Reese Lloyd; school director Fred Burnaford; J. W. Stark and Joseph Dunn.

BRADDOCK, PA.—Braddock council has turned down the request of the Rose Hill Electric Light Company for a franchise in that borough. The request was made in the form of an ordinance which was presented at the July council meeting and the bill was given two readings and referred to the ordinance committee.

AUGUSTA, GA.—The street lighting contract between the city of Augusta and the Augusta Railway and Electric Company expired August 2, and a new contract between the same parties went into effect for four years and three months, at the same rates. The city pays the electric company $69 per year for each light, and at present about 385 lights are in use.

DOVER, N. J.—E. L. Thompson, of Dover, N. J., has purchased the controlling interest of the Rockaway Electric Light Company. Mr. Thompson recently purchased the interests of the Dover Electric Light Company, and without a doubt he will make marked improvement. For a long time past there has been considerable complaint at Rockaway by the consumers of electricity.

TOLEDO, OHIO—For the second time the county commissioners have rejected all bids for the construction of the power-house at the county infirmary. They exceeded the estimate of $27,000, and the commissioners will have to advertise again. A combination bid could have been figured out to come within the total estimate, but the separate bids for the building and equipment were excessive of the separate estimates.

ROCHESTER, N. Y.—The board of supervisors has passed a resolution authorizing the purchasing agent to advertise for bids for the construction of a lighting plant for the court house at a cost not to exceed $7,900. County Engineer J. Y. McClintock will prepare the plans and it is expected the plant will be completed some time this fall. It will be located in the basement of the court house, and will be of sufficient size to insure the most efficient service.

CASHMERE, WASH.—Cashmere is to have electric lights and waterworks as the result of a closely contested election. The proposition to bond the town for $13,200 to construct the light and water plants carried by a good majority, but a difference of opinion as to the best water system caused the proposed system to be approved by a majority of only ten votes. A pumping system being approved, a well will be sunk near the Wenatchee river and a standpipe will be erected on Knob Hill.

SPOKANE, WASH.—The Big Bend Light and Power Company has been incorporated in Spokane with $300,000 capital, by W. L. Sawyer, D. B. Fotheringham, Harry L. Bleecker and Thomas K. Binnie, of Spokane, and Eugene Enloe, of Medical Lake, Wash., to furnish light and power to cities and towns in the Big Bend country, west of Spokane. The Washington Water Power Company, of Spokane, will furnish electrical energy over a high-voltage line. The company will also supply power to flouring mills.

BOSTON, MASS.—The state board of gas and electric commissioners has received a petition from the Gardner Electric Light Company asking for authority to issue $35,000 additional capital stock and $65,000 bonds. The petition recites that the company has property to the value of $115,132.90 and debts of $63,609.79. It is about to install two additional engines and other equipment that will increase this debt some $40,000. The board is to give a public hearing upon the petition.

GOLDFIELD, NEV.—Williard Snyder, of Salt Lake and Ely, with John W. Cawley and associates, of Boston, has purchased the control of the Amalgamated Nevada Mines and Power Company from H. S. Wooley, according to the Ely *Record*, and after having made a thorough examination of the properties has decided to have the power plant in operation at the earliest possible moment, and continue the development of the mines in the Blackhorse district on a more extensive scale than heretofore.

NEW BEDFORD, MASS.—The annual meeting of the New Bedford Gas and Edison Light Company was held on August 6, when reports were submitted and the old board of officers elected as follows: Directors: Horace G. Howland, Thomas H. Knowles, Charles R. Price, George R. Stetson, Frederick Taber, Oliver Prescott, Jr., John S. Perry, Henry M. Knowles, Lot B. Bates, Parkman M. Lund, Frank H. Gifford; treasurer and clerk, Charles R. Price; auditing committee: Henry W. Tripp, George H. Batchelor, Thomas B. Wilcox, Jr.

FORT DODGE, IOWA—At the last meeting of the city council the committee to which was referred the alleged violations by the Fort Dodge Light and Power Company of the franchise under which it is allowed to do business in the city, reported that it recommends the state's attorney be instructed to at once commence proceedings against the corporation to oust it from the city. The recommendations of the committee were favored by the council in the vote which followed, and the matter was referred to County Attorney Price.

ST. ALBANS, VT.—The long-contemplated improvements of the Vermont Power and Manufacturing Company's power plant at Fairfax Falls have been begun. The work includes the deepening of the tail-race channel and the cutting of a flush-gate on the forebay. Howard Bunting, chief engineer, and A. A. Stiles, superintendent of construction of the American Pipe Manufacturing Company, of Philadelphia, are on the ground to oversee the work. It is claimed that when these changes are made that all trouble from floating debris, anchor ice and flood wood will be eliminated.

HENDERSON, TENN.—An election was held here on August 3 to determine the question of whether or not the city should issue bonds to equip and maintain an electric light plant, and the measure was defeated by a vote of fifty-two to eighty-four. The same question was favorably voted upon several months ago, but it afterwards developed that the election was irregular. Since that time an opposition sprung up and the result showed the change of opinion. A private plant had been in operation here until about a year ago, but it closed for want of patronage. It was argued that if private parties were unsuccessful, public ownership would also be. Henderson will continue to remain in darkness.

BATH, ME.—The village trustees have executed a contract with E. J. G. Tower and C. K. DeGroat, of Buffalo, for street lighting for five years after October 5. The Bath Electric and Gas Light Company refused to sign the contract offered it. The price for street lighting will be $62.50 per light, for all-night and every-night service. The total number of lights is to be seventy-five, costing $4,687.50 a year. There is to be an all-day service with a sliding scale of rates for commercial lighting, the highest price being twelve cents per kilowatt-hour and the rate for power motors above one horse-power is to be three cents. The trustees granted Messrs. Tower and DeGroat a forty-year franchise, they to give a bond guaranteeing to have their plant in readiness to furnish the street lights on October 6 and to install within four months a plant to furnish incandescent and commercial lighting. The bond indemnifies the village against any accident that may result from neglect or carelessness in the installation or operation of the electric system in the village.

INDUSTRIAL ITEMS.

THE RICHMOND ELECTRIC COMPANY, Richmond, Va., will send, upon request, full information concerning its R. E. type polyphase induction motor.

SCOFIELD & COMPANY, 150 Nassau street, New York city, has made improvements to the Scofield adjustable swinging telephone bracket. Interesting and attractive literature detailing the merits of this device is now available upon request.

THE DE VEAU TELEPHONE MANUFACTURING COMPANY, 27 Rose street, New York city, has ready for distribution a new catalogue covering common return and metallic circuit intercommunicating patented, ball-bearing, automatic, switchless telephones.

THE WESTERN TUBE COMPANY, Kewanee, Ill., has ready for distribution a bulletin devoted to the "Kewanee" flange union. This is a brass and malleable iron self-sealing ball joint. Full information will be found in this bulletin, which will be furnished upon request to the company.

THE H. O. S. ENGINEERING COMPANY, 16-22 Boyden Place, Newark, N. J., has published a new series of literature discribing and illustrating switches, switch parts, panel-boards and accessories, and "Columbia" and "Columbia-Falcon" alternating-current and direct-current arc lamps.

CHARLES E. DUSTIN COMPANY, 11 Broadway, New York city, will send catalogues to parties desiring information on second-hand electrical and steam machinery. The company is now prepared to quote on single pieces of apparatus or complete outfits for power-house, central station and factory equipment.

THE WESTINGHOUSE MACHINE COMPANY, East Pittsburg, Pa., has published an elaborate catalogue devoted to its storage batteries for stationary service. This describes and illustrates the various types of elements, and gives specifications relating to weights, output and charging rates, measurements and price of parts.

THE FOSTORIA GLASS SPECIALTY COMPANY, Fostoria, Ohio, is mailing an attractive folder calling attention to "Noblac" inner globes. These globes are placed in individual cartons, facilitating the work of unpacking shipments. A return postal card, by which further information may be obtained, is included in the folder.

THE AMERICAN CONDUIT COMPANY, New York, N. Y., has published a very useful booklet entitled "Underground Conduit Construction." This contains a great deal of matter concerning the installation of bituminized fibre conduit. In addition to this there is some valuable engineering data of interest to contractors and engineers engaged in this class of work.

THE SPRAGUE ELECTRIC COMPANY, New York city, has recently issued a seventy-four-page bulletin, No. 229, eight by ten and one-half inches in size, devoted to the application of Sprague electric motors to the printing and allied trades. The progress made in this direction is indicated by the list given of prominent printing, engraving and stereotyping plants equipped with these motors. Progressive printers and those in the allied trades will find in this new publication much of interest and value.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, has published a booklet describing and illustrating "Universal" insulator supports. These insulator supports are made of the best malleable iron, will withstand heavy service demands, and are held rigidly to any surface by cup-pointed, hardened steel set-screws. They can be used in any position on the flanges of any rolled structural shape, beams, angles, channels, "Z"-bars, round, flat, square bars, gas and water pipes, edges of tanks, etc. Full information will be furnished on request.

THE DIELECTRIC COMPANY OF AMERICA, Belleville, N. J., manufacturer of "D. E." weatherproof wire and "H. H." special insulated wire for trying uses, is laying down some interesting installations using its patent system of underground construction. With this system the trench is occupied by a box in which the conductors are run suspended and spaced by porcelain bridges placed at fixed distances in the box. The porcelain bridges are self-locking on the wires and retain them rigidly in place while the insulating compound is poured into the box permanently sealing the wires in a homogeneous dielectric. This system is unaffected by changes in temperature and proof against damage by corrosion. The company announces one installation which has been in continuous use for over two years carrying twenty-four wires, six of which carry 2,200 volts; twelve, 5,500 volts; four, 6,600 volts, and two, 110 volts, without a dollar in expense for repair, or delay in transmission of any kind.

DATES AHEAD.

Jamestown Tercentennial Exposition. Norfolk, Va., April 26 to November 30.

Ohio Electric Light Association. Annual meeting, Toledo, Ohio, August 20-22.

Michigan State Electrical Association. Battle Creek, Mich., August 20-22.

Canadian Electrical Exhibition. Montreal, Quebec, September 2-14.

Canadian Electrical Association. Annual convention, Montreal, Quebec, September 11-13.

Old Time Telegraphers' and Historical Association and Society of the United States Military Telegraph Corps. Annual meeting, Niagara Falls, N. Y., September 16-18.

Colorado Light, Power and Railway Association. Annual convention, Denver, Col., September 18-20.

Railway Signal Association. Annual meeting, Milwaukee, Wis., October 8-10.

American Street and Interurban Railway Association. Atlantic City, N. J., October 14-18.

Record of Electrical Patents.

Week of August 6.

862,127. CENTRIFUGAL SWITCHING DEVICE. Carl B. Auel, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A speed-limiting device.

862,135. AUTOMATIC TROLLEY-RETRACTING MECHANISM. Henry B. Clarke, Highland Park, Ill. A retractor operated by compressed air.

862,146. ELECTRICALLY HEATED SHAFT-FURNACE. Johannes S. Edström, Vesterås, Sweden. An induction furnace.

862,159. TROLLEY. Aaron Hill, Lynn, Mass. An adjustable trolley pole.

862,168. SYSTEM OF CONTROL FOR ELECTRIC MOTORS. Henry D. James, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A controller for alternating-current motors.

862,191. TROLLEY WHEEL. Piatt M. Orlopp, Indianapolis, Ind. A wheel mounted on gimbals.

862,192. CONTROLLING MEANS FOR ELECTRIC MOTORS. William A. Paris, Edgewood Park, Pa., assignor to Westinghouse Electric and Manufacturing Company. A limiting controller for reversing motors.

862,198. SUSPENSION MEANS FOR ELECTRIC MOTORS. Charles A. Psilander, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The supporting springs are seated on the axle bearings.

862,209. ELECTRIC-SIGNAL SYSTEM. Alfred L. Sohm, Los Angeles, Cal., assignor to National Electric Works, Los Angeles, Cal. A rotary-dial call system.

862,211. INSULATOR SUPPORT. William Steiner, Muskegon, Mich. An insulator support for telephone distributing poles.

862,226. MOTOR REGULATOR. George H. Whittingham, New York, N. Y., assignor, by mesne assignments, to the Automatic Switch Company. A speed controller.

862,272. FIELD REGULATOR FOR DYNAMOS. George S. Neeley, St. Louis, Mo. A voltage-regulating system.

862,273. VOLTAGE REGULATOR FOR DYNAMOELECTRIC MACHINES. George S. Neeley, St. Louis, Mo. The voltage is regulated by varying the exciter field resistance.

862,274. VOLTAGE REGULATOR FOR DYNAMOELECTRIC MACHINES. George S. Neeley, St. Louis, Mo. A regulator for exciters for alternators.

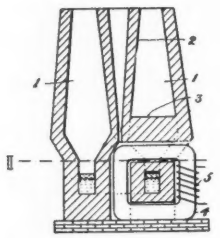
862,277. SPRING FOR TROLLEYS AND HARPS. Ralph E. Noble, Chicago, Ill. A contact spring for trolley wheels.

862,333. METHOD OF CREATING A VACUUM. Peter C. Hewitt, New York, N. Y., assignor to Cooper Hewitt Electric Company, New York, N. Y. A material is placed in the tube, which, when amalgamated, will absorb the residual gases.

862,350. TROLLEY WHEEL. Harry B. Sawyer, Cleveland, Ohio. A sectional wheel.

862,361. ELECTRICAL APPARATUS. Wilbur H. Thompson, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A device for varying the number of exciting turns on a magnetic appliance.

862,397. ELECTRIC-LIGHT CLUSTER. Louis Hruska, Chicago, Ill., assignor of one-half to George De Blois, Chicago, Ill. A method of construction.



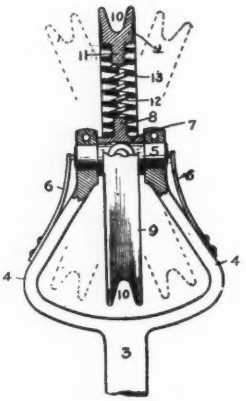
862,146.—Electrically Heated Shaft-Furnace.

862,402. PRINTING TELEGRAPH. Charles L. Krum, Chicago, Ill. The type wheel is shifted and rotated by electromagnets.

862,423. TELEGRAPHIC TRANSMITTER FOR THE MORSE SYSTEM. Theodorus C. Van de Stadt, Aardenburg, Netherlands, assignor of one-half to Josephine Shelton, New York, N. Y. The keys make contact on a roller.

862,441. ELECTRIC CONTROLLING SYSTEM. Charles P. Breese, Norfolk, Va., assignor to Hall Signal Company. A sectional trolley system for railways.

862,442. ELECTRIC-CAR-CONTROLLING SYSTEM. Charles P. Breese, Norfolk, Va., assignor to Hall Signal Company. The car automatically cuts in and out successive sections of the trolley wire.



862,191.—Trolley Wheel.

862,449. HOOK SWITCH. Edward B. Craft, Chicago, Ill., assignor to Western Electric Company, Chicago, Ill. A finger carried on the bottom of the hook lever operates the switch springs.

862,478. WATCH-SERVICE RECORDER. Howard B. Holmes, Park Ridge, Ill., assignor to Western Electric Company, Chicago, Ill. An electrical watchman's recording system.

862,485. TROLLEY WHEEL. Josiah R. Kidney, East Hampton, Ct., assignor to the East Hampton Bell Company, East Hampton, Ct. A bushed wheel.

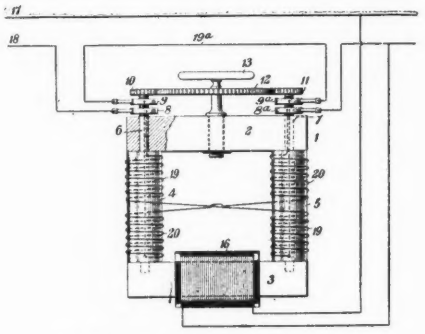
862,497. HOLDER FOR TELEPHONE RECEIVERS. William J. Mogridge, Spokane, Wash. An arm clamped to the transmitter stand.

862,506. INDUCTION-COIL UNIT. Carl A. Pfanstiehl, Highland Park, Ill., assignor, by direct and mesne assignments, to Pfanstiehl Electric Laboratory, North Chicago, Ill. A winding arranged to bring both terminals to the top.

862,513. HIGH-POTENTIAL CIRCUIT-BREAKER. Laforest G. Robinson, Plattsburg, N. Y. Two series of contacts are vibrated in opposite directions.

862,520. ELECTRICAL ROSETTE. James S. Stewart, New York, N. Y., assignor to Annie Stewart, New York, N. Y. Slots are provided for the extension wires.

862,532. ELECTRIC TRANSFORMER. Isaac Anderson, Tacoma, Wash., assignor of one-third to Hans Anstenson, Puyallup, Wash., and one-third to Alfred Sundell, Tacoma, Wash. Means are provided for passing a fluid through air-gaps in the core.



862,361.—Electrical Apparatus.

862,542. CABLE TERMINAL AND SYSTEM OF PROTECTION. Frank B. Cook, Chicago, Ill. A terminal for mounting on a pole.

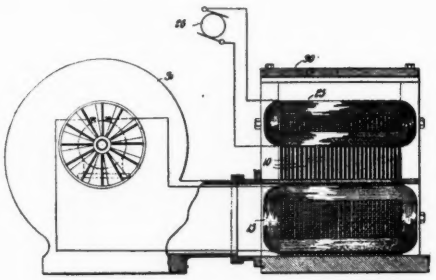
862,580. RELAY. Frank R. McBerty, New Rochelle, N. Y., assignor to Western Electric Company, Chicago, Ill. The armature is mounted on knife-edges.

862,616. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. A central-energy system.

862,618. COUPLING FOR LEAD-COVERED ELECTRIC CABLES. John J. Dossert, New York, N. Y., assignor, by direct and mesne assignments, to Dossert & Company. A mechanical connection.

862,701. TROLLEY WHEEL. William H. Bradt, Schenectady, N. Y. A split wheel.

862,713. TELEPHONE-EXCHANGE SYSTEM. Merritt S. Conner, Rochester, N. Y., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. A manual exchange system.



862,532.—Electric Transformer.

862,740. ELECTRIC CONTROLLING DEVICE. Martin Kallmann, Berlin, Germany. A variation resistance with a high temperature coefficient is used.

862,776. DYNAMOELECTRIC MACHINERY. William L. Waters, Milwaukee, Wis., assignor to National Brake and Electric Company, Milwaukee, Wis. A squirrel-cage induction motor.

862,783. ELECTROLYTIC CELL. Edward A. Allen, Rumford Falls, Me., assignor to Allen Electro-Chemical Company, Rumford Falls, Me. A cell with a mercury cathode which is circulated through two compartments.

862,842. RHEOSTAT. Edwin F. Northrup, Philadelphia, Pa., assignor to the Leeds & Northrup Company, Philadelphia, Pa. The resistance is wound spirally on a ring.